EXPLORING THE DYNAMIC ASSESSMENT PARADIGM AND ITS USEFULNESS AT ASSESSING LEARNING POTENTIAL OF SCHIZOPHRENIA PATIENTS

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SUMMARY

Schizophrenia is a debilitating illness which can impede the functional outcomes of its sufferers even as the illness' symptoms, specifically positive symptoms, have subsided. Researchers and clinicians seek ways to alleviate the negative impact of schizophrenia by studying cognitive deficits' effect on patients' functional outcomes, and possible rehabilitation methods to minimise the impact of these deficits. While the efficacy of rehabilitation effects are generally positive, these intervention programs are time and labour intensive. Hence there is an imperative to find a better fit between a patient's rehabilitation potential and rehabilitation needs, so that limited rehabilitation resources are fully utilised and not wasted on unsatisfactory outcomes. This thesis examines the Dynamic Assessment (DA) paradigm (which involves pre-test, intervention, and post-test phases) as a possible tool in the assessment of Learning Potential – a construct central to the DA paradigm that has been shown to provide indication of schizophrenia patients' rehabilitation potential. DA can potentially enables clinicians to make better informed referral decisions by matching a patient's rehabilitation potential to the appropriate rehabilitation programs. Despite the advantages that DA also provide in terms of allowing clinicians to more fully observe patients' rehabilitation readiness, and its promising practical applicability in predicting Learning Potential, few studies have systematically examined the efficacy of DA. Study 1 therefore investigated whether DA intervention produced performance improvements over-and-above those that would be expected from simple practice effects. Study 2 tested the relationship between Learning Potential (DA's core construct) and intellectual function (IQ), age, medication dosage, and negative

symptoms. Study 1 findings indicated that DA intervention resulted in performance improvements in schizophrenia patients that were over-and-above the practice effect. Study 2 indicated that there was no relationship between Learning Potential and intellectual function, age, medication dosage, or negative symptomatology of the schizophrenia patients studied, suggesting that Learning Potential is a unique construct assessed by DA. Thus, this thesis supports the assertion that DA provides a unique prediction about a schizophrenia patient's Learning Potential, and paves the way for future longitudinal studies to examine more directly the relationship between Learning Potential and rehabilitation and long-term functional outcomes in patients with schizophrenia.

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Chapter 1: Schizophrenia and Cognitive Impairment

Schizophrenia is a mental disorder that has intrigued clinicians and researchers alike since its description by Kraepelin in the late 19th century. Since then, there have been many scholarly discussions and scientific studies of this debilitating illness, ranging from the causes of schizophrenia, the symptoms displayed by schizophrenia patients, the development of the illness, the treatment choices, and the treatment outcomes of schizophrenia. This thesis starts with a literature review of the cognitive deficits typically observed in schizophrenia patients. An understanding of these cognitive deficits will be helpful in formulating interventions aimed at ameliorating these cognitive deficits. The efficacy of cognitive rehabilitation for schizophrenia patients is reviewed in Chapter 2, followed by an introduction to the Dynamic Assessment (DA) paradigm (which has been proposed as being helpful in predicting rehabilitation potential of schizophrenia patients) in Chapter 3. Chapters 4 and 5 describe the experimental studies of this thesis that were aimed at investigating the viability of Dynamic Assessment, and an overall discussion of these results and concluding remarks is set out in Chapter 6.

The Origin of Schizophrenia

Our understanding of mental disorders, such as schizophrenia, has not always been founded on scientific beliefs. Until the time of Hippocrates, any understanding of mental illness was guided by influential thinkers who asserted their (sometimes misguided) beliefs. Hippocrates, who is typically regarded as the father of medicine, began a more evidence based biological approach towards mental illness, which he termed as madness, by attributing

its aetiology to physiological rather than supernatural factors. Hippocrates' biological approach to mental illness was however interrupted during the Middle Ages under the strong influence of the church, and mental illness was once again attributed to supernatural forces such as witchcraft or the devilish possession of the body (Palha & Esteves, 1997).

The Age of Reason, or the Enlightenment, in the 17th and 18th century, was the scientific era of great thinkers and scientists such as Copernicus, Galileo, Descartes, Pascal and Newton. During this period, understanding and debate about mental illness once again took on a more scientific approach. Another important reform during this period was the more humane treatment of mental patients (Palha & Esteves, 1997). In the 19th century, the first case of schizophrenia as a disorder akin to what we understand it in today's time, was documented and reported in Bethlem Hospital. It was a patient by the name of James Tilly Matthews who had been in Bethlem Hospital for thirteen years before his case was documented and described by doctors (Stone, 2006). It was also during the 19th century that Benedic Morel first coined the term "dementia praecox" to describe schizophrenia and also the first to attribute hereditary factors behind the cause of schizophrenia (Palha & Esteves, 1997).

However, it was only in the late 19th century before Kraepelin provided us with a comprehensive description of schizophrenia after a long period of careful observations of his patients. He broadened Morel's notion of dementia praecox and added the idea of predisposed diffused cerebral pathology into his description of the disorder (Palha & Esteves, 1997). He also considered what

we now term “negative symptoms”, as the fundamental symptoms of schizophrenia (Andreasen, 1997). Eugen Bleuler further refined this diagnostic category by dividing the symptoms into two broad categories which he referred to as fundamental and accessory symptoms. The fundamental symptoms, which are similar to today’s notion of “negative symptoms”, included the loss of continuity of associations, loss of affective responsiveness, loss of attention, loss of volition, ambivalence, and autism. On the other hand, the accessory symptoms, which are similar to today’s “positive symptoms”, included delusions and auditory hallucinations (Andreasen, 1997). Although Kraepelin and Bleuler helped to recognize the different types of symptoms present in schizophrenia patients, one of the earliest and most prominent users of the terms “positive symptoms” and “negative symptoms” (that we use today) was Hughlings-Jackson who thought of negative symptoms as a loss of normal functioning, and positive symptoms as an exaggeration of normal functioning (Andreasen, 1997).

Following Kraepelin’s and Bleuler’s description of schizophrenia, negative symptoms were increasingly emphasized as the central symptoms of the disorder, until this emphasis later shifted in the 1960s and 1970s to focus on positive symptoms, for a variety of reasons. One of these reasons was the influence of Kurt Schneider’s work, who noted that the inability to distinguish between self and not-self and a loss of the sense of personal autonomy were critical components of schizophrenia. As these impairments were usually caused by delusions and hallucinations, the emphasis therefore shifted to positive symptoms of schizophrenia. Another reason was the fact that negative

symptoms were difficult to define and rate reliably, often because these symptoms were usually also found in healthy people (with subtle differences in severity and frequency) hence resulting in the increased risk of over-diagnosing schizophrenia in the healthy population. The popular acceptance of Schneider's ideas during this period, in confluence with the difficulty in defining negative symptoms, resulted in the shift of emphasis to positive symptoms which appeared more clearly as markedly abnormal behaviours. This emphasis was strengthened especially when these symptoms were included as diagnostic criteria such as in the third edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM) (Andreasen, 1997).

Today, there is a more balanced view of both positive and negative symptoms as important features of schizophrenia (Andreasen, 1997), and our understanding of schizophrenia will no doubt continue to evolve as research continues on this disorder. Nevertheless, acknowledgement must be given to those who came before us in the study of schizophrenia, especially the early writings of Kraepelin and Bleuler who provided us with a conceptual foundation for the study and understanding of schizophrenia today.

Diagnosing Schizophrenia

There are two alternative systems that clinicians can use to diagnose mental disorders: the Diagnostic and Statistical Manual of Mental Disorders (DSM) and the International Classification of Diseases (ICD). The DSM was developed in the United States, and has gone through many editions – the current edition is the revised fourth edition (DSM-IV-TR) with a fifth edition

in the pipeline which is expected in the near future (American Psychiatric Association, 2010).

The ICD is maintained by the World Health Organization (WHO), and currently its tenth edition (ICD-10) has been in use since 1994. Other than diagnostic information, the ICD-10 also provides a unified method for the compilation of national mortality and morbidity statistics by various member states of the WHO (World Health Organization, 2011).

Despite their differences, the two diagnostic systems are roughly equivalent and the choice of diagnostic systems depends very much on the locale in which the clinician is practising, and also the clinician's training and preference. To diagnose a person with schizophrenia by DSM-IV-TR, the clinician rates the person on six diagnostic criteria. The person must have two or more of the following symptoms for a significant portion of time during a 1-month period: delusions, hallucinations, disorganized speech, grossly disorganized or catatonic behaviour, or negative symptoms (Criterion A). However, only one Criterion A symptom is required to meet the diagnosis if the symptom consists of bizarre delusions or auditory hallucinations. The diagnosis can also be made if some signs of the disorder persisted for at least six months (Criterion C) and that there are at least one month of symptoms that meet Criterion A. The conditions of schizophrenia also include impairment in social or occupational functioning (Criterion B). Finally, the diagnosis of schizophrenia can only be finalized when schizoaffective or mood disorder (Criterion D) and physiological effects of a substance or a general

medical condition (Criterion E) are ruled out as the causes of the symptoms. If the person has a history of autistic disorder or another pervasive developmental disorder, schizophrenia can be added to the diagnosis if delusions or hallucinations are present for at least a month (Criterion F) (American Psychiatric Association, 2000).

To meet the ICD-10 criteria for a diagnosis of schizophrenia, nine symptoms are considered, and are categorized into two groups. The first group contains four positive symptoms such as thought echo, insertion or withdrawal or broadcasting, delusions, and hallucinations. The second group contains five symptoms with some negative symptoms like catatonic behaviours, disorganized thoughts, blunted affect, and marked apathy. Meeting the ICD-10 diagnosis of schizophrenia requires the presence of at least one very clear symptom (and usually two or more if less clear-cut) from the first group of symptoms. Diagnosis can also be made if at least two symptoms from the second group of symptoms have been present for most of the time for at least one month. The ICD-10 also acknowledges that a decrease in social and functioning level can precede the onset of schizophrenia symptoms. Similar to DSM-IV-TR, schizophrenia can only be diagnosed when extensive mood disturbances, and other organic causes like brain disease or substance use have been ruled out (World Health Organization, 1992).

Cognitive Deficits in Schizophrenia Patients

Besides the positive and negative symptoms seen in schizophrenia patients, cognitive deficits are also a central feature of schizophrenia. The domains of

cognitive deficits suffered by patients include speed of processing, attention/vigilance, working memory, verbal learning and memory, visual learning and memory, reasoning and problem solving, verbal comprehension, and social cognition (Nuechterlein et al., 2004). It was reported that when comparing their means on standard neuropsychological tests, 80% of schizophrenia patients performed at least one standard deviation below matched healthy controls, and 50.6% of schizophrenia patients performed at least two standard deviations below matched healthy controls (Wilk et al., 2004). Besides identifying the cognitive deficits seen in schizophrenia patients, it is also important to understand how these deficits manifested throughout the span of the disorder so that clinicians can anticipate such changes and make timelier and more appropriate treatment decisions for these patients.

Two trajectories have been proposed for the cognitive changes in schizophrenia patients: one trajectory that proposes a progressive decline of cognitive abilities and another trajectory that proposes a stabilization of cognitive deficits after the onset of schizophrenia. A suggestion for the trajectory of cognition deficits decline among schizophrenia patients is that cognitive function will deteriorate the most in the first five years of illness. This is followed by a stabilization of function or even improvement. Further deterioration may occur especially if negative symptoms persist. Bilder et al. (1992) assessed the cognitive function of three groups of participants: first-episode schizophrenia patients, chronic schizophrenia patients, and healthy participants. By examining the results from the subtests of the Wechsler Adult

Intelligence Test - Revised (WAIS-R) administered to the three groups of participants, poorer performance on the WAIS-R by the first-episode schizophrenia patients and the chronic schizophrenia patients compared to the healthy controls, suggested poorer cognitive function for both patient groups. However, when the severity of cognitive deficits was compared between the first-episode patients and the chronic patients, the severity of cognitive deficits was less in the first-episode patients compared to the chronic patients. By definition, the length of illness was longer for the chronic patients compared to the first-episode patients, and their relatively poorer cognitive function could therefore be explained as the result of progressive deterioration of the cognitive function with time, lending support to the observation of slow progressive deterioration of cognitive function in schizophrenia patients. This trajectory of slow cognitive decline in schizophrenia patients has been termed the neurodegenerative model.

On the other hand, some studies have suggested that cognitive deficits remain relatively stable over long periods of time following the onset of schizophrenia. A review of longitudinal studies of cognition of schizophrenia patients found that verbal skills, memory, and pre-attentional information processing were the most stable cognitive deficits, while complex attention and concentration, set-response-shift, and attention span were the less stable deficits (Rund, 1998). Rund (1998) suggested that the more stable cognitive deficits did not show any decline beyond what was expected from normal aging over time. Rund (1998) also suggested that the less stable deficits were episodic-like and related to the fluctuation of symptoms. In addition some

other cognitive deficits were characterized as intermediate factors, meaning that they were prominent in acute psychotic state and subsided (although did not completely disappear) during remission.

These two postulations about the trajectory of cognitive decline can be viewed as opposite ends of the spectrum seen among schizophrenia patients. The only similarity between the two trajectories is that cognitive function shows some improvement following remission after the acute phase of the illness, after which the two trajectories differ in the progression of these deficits. From the clinicians' point of view, the progression of the deficits plays an important part when devising a treatment and rehabilitation plan for patients. If a patient's cognitive functions progressively deteriorate, the rehabilitation plan may need to include provisions for increasing aid to the patient as the patient's cognitive status declines. However, if the deterioration eventually stabilises, the more efficient rehabilitation plan may be to wait for the stabilisation before teaching coping strategies for residual deficits. The characteristic of the course of cognitive deficits therefore has implications for treatment and rehabilitation planning.

To shed more light on the trajectory of cognitive decline in schizophrenia patients, Bonner-Jackson, Grossman, Harrow, and Rosen (2010) followed a group of patients with different mental illnesses including schizophrenia, other types of psychotic disorders (psychotic depression, psychotic bipolar disorders), and nonpsychotic disorders (nonpsychotic depression) over a 20-year period. Cognitive function, specifically processing speed and the ability

to access general knowledge, was assessed over seven time points over the 20-year period (once at acute phase upon hospitalization and six more times spanning the next 20 years). The results showed that schizophrenia patients were most impaired at the acute phases compared to the other mental illness groups. This acute phase was followed by a recovery of some cognitive functions and relative stability in cognitive status over the 20-years period. This study therefore provides support to Rund's (1998) view of the post-acute-phase stability of cognitive status over time in schizophrenia patients. Such a projected trajectory for cognitive function in schizophrenia patients suggests that treatment and rehabilitation planning should incorporate interventions that can help patients cope with the effects of residual cognitive deficits. There is therefore a pressing need for tools to help clinicians more accurately assess the type and level of intervention required by their patients based on their post-acute-phase residual cognitive function deficits.

The Relationship between Cognitive Impairments and Functional Outcomes Among Schizophrenia Patients

With cognitive deficits being established as a core feature of schizophrenia, it would be important to know the impact these deficits have on the functional outcome of schizophrenia patients (Tan, 2009). Research on functional outcomes in schizophrenia patients usually involves studies at the level of community outcome (e.g., being able to work or go to school), social problem solving ability and psychosocial skill acquisition. A review by Green, Kern, Braff, & Mintz (2000) suggested that 20% to 60% of variance in functional outcomes of patients could be explained by composite measures of cognition.

Further analysis found significant relationships between specific cognitive functions and functional outcomes with medium to large effect sizes. For example, it was found that executive functioning (as measured by the Wisconsin Card Sorting Test) was related to patients' community outcome. This suggests that studying a schizophrenia patient's performance on tests of executive function can provide an indication of how the patient is going to function in daily life activities such as in school or at work. A recent study by Nuechterlein et al. (2011) also showed that cognitive functions such as working memory, verbal memory and processing speed, and attention and early perceptual processing abilities measured at a stabilised phase of the illness process among first episode schizophrenia patients predicted vocational outcome. Nuechterlein et al. (2011) recruited 47 patients and assessed their cognition with the Degraded Stimulus Continuous Performance Test, the Span of Apprehension, the Trail Making Test, the Digit-Span Distractibility Task and the California Verbal Learning Test, as well as assessed the patients' functional outcomes by the work section of the Social Adjustment Scale. It was found that these cognitive functions accounted for 52% of the variance related to whether the patients returned to paid work or schooling within 9 months. Thus cognitive deficits suffered by schizophrenia patients appear to be related to their functional outcomes: poorer functional outcome is associated with poorer cognitive function.

There is no doubt that the reduction of psychotic symptoms is a priority goal when treating schizophrenia patients, but the next stage of treatment could be to help patients with their functional outcomes by focusing on their cognitive

deficits. For example, using cognitive rehabilitation programs to help return them as closely as possible to their pre-morbid level of cognitive function. With the evidence pointing towards a relationship between cognitive deficits and a patient's functional outcome, clinicians will need to consider these cognitive deficits when planning any treatment approach that is aimed at improving a patient's functional outcome (Gopal & Variend, 2005; Green, Kern, & Heaton, 2004). Therefore, it is important to incorporate into the treatment, approaches that target cognitive functions of schizophrenia patients – approaches such as cognitive rehabilitation which will be discussed in more detail in the following chapter.

The Relationship between Cognitive Impairments and Schizophrenia Symptoms

Besides charting the course of cognitive deficits, researchers have also attempted to establish the relationship between cognitive deficits and the symptoms of schizophrenia. It was discussed previously that although certain cognitive deficits seen in schizophrenia patients may be episodic-like and less stable, and linked to fluctuations of symptoms (see Rund (1998)), cognitive performance is generally thought to remain stable despite variation of symptomatology over time (Heaton et al., 2001). With only modest relationship between negative and disorganization symptoms and cognitive ability (correlation between -0.15 to 0.30), and a minimal relationship between positive symptoms and cognitive performance, studies seem to suggest that cognitive impairment seen in schizophrenia patients is generally independent from their schizophrenia symptoms (Gold, 2004). Family studies further

support the dissociation between cognitive impairments and symptoms. The (symptom free) first-degree relatives of schizophrenia patients show marked cognitive impairments similar to the patients themselves (Egan et al., 2001), despite their lack of (even sub-threshold) symptoms, thus supporting the notion that cognitive deficits and clinical symptoms of schizophrenia are independent of each other (Gold, 2004).

As a cautionary note, a diagnosis of schizophrenia is however a categorical boundary, as it is of course possible that non-affected relatives are closer to that boundary than unrelated healthy controls. A closer look at research findings will show that the independence of symptoms and cognitive deficits of schizophrenia patients is mostly for positive symptoms and not negative symptoms. For example, Potter and Nestor (2010) found that schizophrenia patients with more decline in intellectual functions tended to have more negative symptoms. A group of schizophrenia patients (n = 73) was recruited in an attempt to validate a model of cognitive subtypes of patient (i.e., three subtypes namely intellectual preserved - patients whose intellectual function did not change from premorbid levels; intellectual compromised - patients with consistently low intellectual function; and intellectual deteriorated - patients whose intellectual function declined after the onset of the disorder). A comprehensive neuropsychological assessment was conducted that included the Wechsler Adult Intelligence Scale, Wechsler Memory Scale, Wisconsin Card Sorting Test and Trail Making Test, as well as the Positive and Negative Syndrome Scale which was also administered to assess the patients' schizophrenia symptoms. The results showed significant difference in

cognitive functions in the three groups of patients with progressively poorer cognitive functions in the order of the intellectual preserved group, the intellectual deteriorated group, followed by the intellectual compromised group. The results also showed that the intellectual compromised group had significantly higher negative symptom ratings, followed by those of the intellectual deteriorated group, compared to the negative symptom ratings of the intellectual preserved group. The intellectual compromised group and the intellectual deteriorated group also had more negative symptoms than positive symptoms while the opposite was true for the intellectual preserved group (who had more positive symptoms than the intellectual deteriorated group). Thus Potter and Nestor (2010)'s results supported the dissociation of positive symptoms from cognitive functions (since having more positive symptoms was associated with higher cognitive functions i.e., among the intellectual preserved group, and having less positive symptoms was associated with poorer cognitive functions i.e., among the intellectual deteriorated group). However for negative symptoms, the pattern of manifestation across the groups of schizophrenia patients consistently showed poorer cognitive function was associated with higher ratings of negative symptoms. This shows that the relationship between schizophrenia symptoms (specifically positive versus negative symptoms) and cognitive deficits is not straight-forward. The moderate relationship between negative symptoms and cognitive deficits has received further evaluation, and the findings that bear relevance to functional outcomes of schizophrenia patients are reviewed briefly in the following section.

Negative Symptoms and its Relationship to Functional Outcomes of Schizophrenia Patients

Schizophrenia is characterized by both positive and negative symptoms, but both types of symptoms have different patterns of manifestation during the course of the illness. While positive symptoms tend to remit with medication, negative symptoms tend to be more stable and persistent. Negative symptoms also tend to appear in the later stages of the acute phase of the illness or at the later stages of the illness among first-episode schizophrenia patients (Addington, 2000). However, what draws the attention of researchers specifically to the negative symptoms of schizophrenia is its relationship with the cognitive functions of patients. As discussed earlier, research findings tend to support the idea that negative symptoms are related to cognitive function of schizophrenia patients with more severe negative symptoms associated with poorer cognitive functions (see Potter & Nestor (2010)). Because of the relationship between cognitive functions and functional outcome of schizophrenia patients, the association between negative symptoms and cognitive functions may indicate that negative symptoms have some association with functional outcomes of patients too. This has prompted researchers to investigate other possible interactions between negative symptoms and the functional outcome of schizophrenia patients.

One such area of research is the predictive value of negative symptoms for the functional outcomes of schizophrenia patients. Siegel et al. (2006) recruited 98 schizophrenia patients and assessed them with the Scale for the Assessment of Positive Symptoms (SAPS), Scale for the Assessment of Negative Symptoms

(SANS), and the Hamilton Depression Rating Scale (HAM-D) at intake and at a 6-month follow-up. Functional outcome was assessed by the Strauss-Carpenter Level of Function Scale at two to eight years after intake. It was found that higher overall functional outcome at follow-up (after an average of three years after initial assessment) was predicted by less severity of negative symptoms at intake. However, a similar predictive result was also obtained for positive and depressive symptoms. Thus this prompted Siegel et al. (2006) to suggest that it was the intensity of symptoms suffered by schizophrenia patients rather than the type of symptoms they suffered that predicted the functional outcomes of these patients. Thus Siegel et al. (2006) did not find that negative symptoms were specifically helpful in predicting the functional outcomes of schizophrenia patients.

As part of a study assessing the efficacy of the MATRICS consensus cognition battery (MCCB), Shamsi et al. (2011) recruited 185 schizophrenia patients and collected information on the symptoms and their functioning levels. Patients were assessed using the Brief Psychiatric Rating Scale (BPRS), the SANS, and the Hamilton Rating Scale for Depression (HRSD-24). The functioning level of patients were assessed using the Multidimensional Scale for Independent Functioning (MSIF), and the Social Adjustment Scale-II (SAS-II), which focused on work function, residential status, and social functioning. Analysis of the predictive value of negative symptoms showed that residential status (i.e., living or not living independently) could not be predicted by negative symptoms. However, the patients' negative symptom ratings were predictive of the patients' social and work functioning levels. No such

predictive value was found for the patients' positive symptom ratings. Unlike Siegel et al. (2006), Shamsi et al. (2011) found specific association between negative symptoms (but not positive symptoms) and the functional outcomes of schizophrenia patients: Shamsi et al. (2011) showed that negative symptoms were related to functional outcomes (i.e., social and work function outcomes).

The association between negative symptoms and cognitive function of schizophrenia patients is further supported by a meta-analysis of 73 studies by Ventura, Hellemann, Thames, Koellner, and Nuechterlein (2009) which showed a significant moderate relationship between schizophrenia patients' negative symptoms and their performance on cognitive tests (r = -.24, p < .01). In addition, Ventura et al. (2009) also found a significant relationship (r = -.42, p < .01) between negative symptoms and functional outcome (i.e., community functioning such as work or school performance). Further analysis showed that the rating for negative symptoms was a mediating factor between cognitive performance and functional outcome. However, there was no relationship between positive symptoms with cognitive performance or with functional outcome. Thus research studies and meta-analysis reflect a sentiment that negative symptoms and functional outcomes of schizophrenia patients are clearly associated with each other. However, the path of influence is yet to be agreed, as extant research points to both a direct association between negative symptoms and functional outcome, as well as a moderating effect that negative symptoms exert on the functional outcome of schizophrenia patients through their impact on cognitive functioning.

Regardless of these mixed opinions, the consensus is that negative symptoms continuous presence affect functional status of the patients, unlike positive symptoms which seems to subside and have minimal impact on the functional outcome of the patients. While more needs to be done to clarify negative symptoms' role in patients' functional outcomes, current research on found association between the two factors means negative symptoms will need to be considered as treatment target, or at least to be taken into account when clinicians formulate their treatment plans for improving functional outcomes of schizophrenia patients.

Concluding Comments on Cognitive Deficits and Functional Outcome of Schizophrenia Patients

That cognitive deficits are a core symptom of schizophrenia is now well-documented and well-established in the schizophrenia literature (Heinrichs, 2005). With evidence also mounting on the relationship between cognitive deficits and the functional outcome of patients, a comprehensive treatment and rehabilitation approach intended to improve a patient's functional outcome will also need to consider the factor of cognitive deficits. However, this approach is not straightforward because other factors such as negative symptoms may also moderate or even have a direct impact on the functional outcome of these patients. Further research will be required to sort out the precise nature of the associations between cognitive function, negative symptoms, and functional outcomes of schizophrenia patients. However, this does not mean that treatments that target any of these factors should be stopped until a clearer

picture of the association emerges from research findings. The next chapter will review cognitive rehabilitation as a treatment option to improve schizophrenia patients' functional outcomes and to also attempt to establish the efficacy of this treatment approach.

Chapter 2: The Role of Cognitive Rehabilitation in the Treatment for Schizophrenia

In the previous chapter, the negative impact of cognitive deficits on functional outcome in schizophrenia patients was discussed. Therefore, a comprehensive treatment plan for schizophrenia patients should also include interventions that target the cognitive deficits in order to improve patients' functional outcomes. That such a view is widely accepted by this field can be seen from the different initiatives (i.e., the Measurement and Treatment Research to Improve Cognition in Schizophrenia (MATRICS) initiative and the Clinical Antipsychotic Trials of Intervention Effectiveness (CATIE) project) that were set up to conduct more direct research on the relationship between cognition and functional outcome (Green et al., 2004; O'Halloran et al., 2008). This chapter will examine the different types and the efficacy of interventions (with the focus on cognitive rehabilitation) aimed at improving cognitive functioning of schizophrenia patients.

Treating Schizophrenia

It is important to appreciate that the opportunities to treat disorders such as schizophrenia are not only limited to times when symptoms are manifesting. To illustrate, Tandon, Nasrallah, and Keshavan (2010) highlighted that disease modification is possible in the form of preventive measures before the manifestation of disease, early intervention during the early manifestation stages of disease, treatment to prevent disease progression and disability, and intervention efforts to cope with the effects of disease. In the case of schizophrenia, disease modification can start with (and is not necessarily

limited to) early screening of at-risk children, counselling and education about illness to prevent relapses for first-episode cases, medication to reduce psychotic symptoms during the active phase of illness, and rehabilitation intervention to cope with residual effects of schizophrenia and to reintegrate patients back into the society when their illness has stabilised. Thus a comprehensive treatment plan is one that incorporates various interventions at several different phases of disease progression. As it is not the intended focus of this thesis to review the treatment opportunities available to every phase in the progression of schizophrenia, this review will focus on examining treatment opportunities available to schizophrenia patients who have already manifested their symptoms and the progression of the illness is at the stage when they are now trying to cope with the effects of the disorder.

Antipsychotic Medications and its Effects on Cognitive Deficits and Functional Outcome of Schizophrenia Patients

It is unequivocal that medication is the first choice of treatment intervention for schizophrenia patients in the active phase of the illness. However the use of antipsychotic medication to treat schizophrenia patients only started in the 1960s despite schizophrenia being identified as a separate disorder by Kraepelin since the late 19th century. Before the advent of antipsychotic medication, schizophrenia patients were offered a standard treatment of a long-stay in a (hopefully safe and supportive) psychiatric hospital with the hope that the symptoms would remit spontaneously (Tandon et al., 2010). With the invention and prescription of antipsychotic medications, many

patients see a reduction of their symptoms, specifically the positive symptoms associated with schizophrenia.

However, first-generation (also known as typical or classical) antipsychotic medications had unpleasant side effects such as acute extrapyramidal symptoms and tardive dyskinesia (Crilly, 2007)**.** This issue was resolved with the invention of second-generation (also known as atypical) antipsychotic medications. Besides resulting in fewer side effects, atypical antipsychotic medications also seemed to result in better cognitive functions (for a review see e.g., Sharma and Harvey 2000). Hori et al. (2006) recruited schizophrenia patients who were prescribed either typical or atypical antipsychotic medication. These patients were subsequently administered a series of neuropsychological tests including the Wechsler Memory Scale-Revised (WMS-R), Wechsler Adult Intelligence Scale-Revised (WAIS-R), Wisconsin Card Sorting Test (WCST), and Advanced Trail Making Test (ATMT). The results showed that patients on atypical antipsychotic medication (in this case olanzapine and risperidone) performed better on the neuropsychological assessments compared to the patients on typical antipsychotic medications. This effect was seen specifically in the areas of visual memory, delayed recall and executive functions. The decreased need for patients on atypical medication to be prescribed additional drugs to counter the neurological side effects could however be one of the reasons why these patients who were medicated with atypical anti-psychotics showed better cognitive functioning. A recent review of studies comparing atypical antipsychotic medicated with typical antipsychotic medicated schizophrenia patients suggested that pro-

cognitive effects of atypical antipsychotic medication were not always consistently found, and that atypical antipsychotic medication was not always associated with better cognitive or social outcomes (Tandon et al., 2010).

While both atypical antipsychotic medication and typical antipsychotic medication seem equally effective in the reduction of positive symptoms, they differ in their effectiveness in reducing negative symptoms in schizophrenia patients (Tandon, Nasrallah, & Keshavan, 2009). Rocca, Montemagni, Castagna, Giugiario, Scalese, and Bogetto (2009) examined whether negative symptoms could be predicted by the prescribed type of antipsychotic medication. Their regression model showed that neither typical nor atypical antipsychotic medication could be used to predict negative symptoms, suggesting the independence between medication type and negative symptoms.

With such inconsistency across different studies of the effectiveness of atypical antipsychotic medication on the enhancement of cognition among schizophrenia patients, more investigation will be required before a firmer conclusion can be made (Sota & Heinrichs, 2004). If antipsychotic medication does not affect the cognitive function of schizophrenia patients, then a treatment plan aimed at improving functional outcome of schizophrenia patients that solely relied on antipsychotic medication would be less effective given that cognitive functions are closely intertwined with functional outcomes of schizophrenia patients. This was the conclusion drawn by Tandon et al. (2010) in their review of studies on atypical antipsychotic medications

and functioning outcome of schizophrenia patients. Hence, for clinicians who aim to improve functional outcome of schizophrenia patients, besides antipsychotic medication, it may well be useful to incorporate other types of treatment intervention such as cognitive rehabilitation.

Characteristics of Cognitive Rehabilitation Programs

The attempt to ameliorate cognitive deficits is not limited to schizophrenia patients. In fact, documented attempts to improve cognitive deficits began in the early 1900s when cognitive rehabilitation was provided to soldiers with traumatic brain injuries sustained during World War I (Twamley, Jeste, & Bellack, 2003). Interest in using cognitive rehabilitation to help schizophrenia patients began in the 1970s after studies examined the effect of asking schizophrenia patients to use self-talk when problem-solving (Meichenbaum & Cameron, 1973; Bellack, Gold, & Buchanan, 1999). Unfortunately, the results from these early studies on cognitive training were not easily replicated and interest in cognitive training waned. At the same time, researchers also shifted their focus towards a neurobiological approach in the treatment of schizophrenia patients. This included the use of psychopharmacological interventions, but as discussed in the previous section although antipsychotic medications (both typical and atypical) help relieve psychotic symptoms and prevent relapses and rehospitalisation, their effectiveness in reducing cognitive impairments and improving patients' functional status is mixed (Bellack et al., 1999; Silverstein & Wilkniss, 2004). Thus, interest in using cognitive rehabilitation as a means to improve cognitive and functional deficits has been rekindled (Twamley et al, 2003).

Rehabilitation intervention can take many different forms. Compensatory-focused rehabilitation intervention helps patients to overcome their deficits by employing coping strategies (e.g., cognitive strategies like over learning a skill to reduce the load on working memory). Environmental approaches to rehabilitation manipulate the environment (e.g., by carrying around lists or cue cards) to overcome deficits (Twamley et al., 2003). For cognitive rehabilitation, a review of the literature showed that cognitive interventions usually featured either compensatory or environmental approaches (Bellack et al., 1999). Regardless of the nature of rehabilitation strategy, cognitive rehabilitation is generally understood as a "behavioural intervention designed to improve cognition in people who have suffered a decline in neuropsychological functioning" (Medalia & Richardson, 2005). Note that cognitive rehabilitation is different from cognitive therapy, the latter being a cognitive-content focused treatment aimed at modifying a schizophrenia patient's psychotic thoughts (Rund & Borg, 1999).

Different types of cognitive rehabilitation programs are available for schizophrenia patients. Both individualized and group treatment programs are available, and some use computerized methods while others use non-computerized methods (Silverstein & Wilkniss, 2004). Cognitive rehabilitation treatment for schizophrenia patients can also be subdivided into programs that use automated, drilled-oriented ("bottom up") approaches from those that use strategy-oriented ("top down") approaches (Twamley et al., 2003). Tomas, Fuentes, Roder and Ruiz (2010) reviewed different cognitive

rehabilitation programs and categorized them into three groups according to the approach used with patients: training programs to enhance cognition; compensatory rehabilitation programs; and training programs using computers. Recently, training on specific types of video games that promote flexible use of different strategies has also been demonstrated by researchers as an effective way to improve cognition in the healthy elderly population (Boot, Kramer, Simons, Fabiani, & Gratton, 2008; Basak, Voss, Erickson, Boot, & Kramer, 2011). Regardless of the variety of cognitive rehabilitation programs for schizophrenia patients or how the programs are categorised by researchers or clinicians, these programs have the same aim: to remediate cognitive deficits with the hope of improving functional outcomes of the patients.

The Efficacy of Cognitive Rehabilitation Programs

The likely efficacy of any treatment, including cognitive rehabilitation, is an important factor to consider before prescribing it to patients. The discussion that follows will examine the efficacy of cognitive rehabilitation programs for schizophrenia patients. Since memory, attention, and executive functions have been identified to be most related to functional outcomes of schizophrenia patients (Green et al., 2000), the discussion will focus on cognitive rehabilitation programs that target these cognitive functions. Specifically, computer-assisted rehabilitation programs that target these cognitive functions will be discussed since more and more of such programs are developed with the advancement in technology.

One of such computer-assisted rehabilitation programs was initiated by Kurtz, Seltzer, Shagan, Thime, and Wexler (2007). To investigate the effectiveness of computer-assisted cognitive rehabilitation programs, groups of schizophrenia and schizoaffective patients were recruited to undergo different computer-assisted training programs. Twenty-three patients were randomly selected to undergo a 12-month cognitive rehabilitation program using a series of computerized cognitive exercises intended to improve attention, verbal and non-verbal memory, and language processing through a repeated drill-and-practice approach. Nineteen patients acted as controls and underwent a computer-skills control intervention program which involved training in general computer literacy and the usage of Microsoft Office. Both groups of patients received similar amount of intervention time and interaction time with the clinicians so as to eliminate confounds such as exposure to computer and social interaction.

To assess improvement in cognitive functions, all patients received a series of neuropsychological assessments pre- and post-intervention. The assessment domains included the Digit Span, Arithmetic, and Letter-Number Sequencing subtests from the Wechsler Scale of Adult Intelligence - III (WAIS-III) for working memory, the Logical Memory I and II subtests from the Wechsler Memory Scale - III (WMS-III), and the California Verbal Learning Test - II (CVLT-II) for verbal episodic memory, the Digit Symbol and Symbol Search subtests of WAIS-III, the Trail Making Test, the Grooved Pegboard, and the Letter Fluency for speed of information processing, the Rey Complex Figure Test for visual episodic memory, and the Block Design subtest of the WAIS-

III, the Penn Conditional Exclusion Test, and the Booklet Category Test for reasoning and problem-solving skills. Using a mixed design *ANOVA* (time x group) to assess performance on each of the five cognitive domains, the results showed that both groups of patients improved on all five cognitive domains. A significant time x group interaction for working memory indicated that patients who had undergone the computerized cognitive exercises improved more relative to the patients who had undergone the control intervention. Analysis of individual patients' scores for the working memory domain showed that 61% and 22% of patients in the computerized cognitive exercise group showed at least a small (more than .2 standard deviation) and a large (more than .8 standard deviation) *z*-score improvement from pre- to post-intervention assessment respectively. On the other hand, only 42% of the patients in the control condition showed a small to medium size *z*-score improvement and none of them had a large *z*-score improvement. This difference in frequency of large versus none or small to medium size z-score improvements between the two groups of participant was also significant. This study showed that improvement in cognition could be produced by simple exposure to non-specific computer training, and that further improvement in a specific cognitive domain such as working memory could be achieved through targeted computerized cognitive training exercises.

A more recent study investigated the efficacy and the durability of training effects resulting from a computer-assisted neuroplasticity-based cognitive remediation program aimed at helping schizophrenia patients (Fisher, Holland, Subramaniam, and Vinogradov, 2010). Thirty-two patients were recruited and

randomly assigned to either the computerized cognitive training program or a computer games control condition. The cognitive training program was developed by PositScience, Inc. and the program specifically targeted early information processing functions, working memory capacity, and cognitive control. Of the 22 assigned to the cognitive training program, 12 patients underwent 50 hours of auditory-based cognitive training while 10 patients had an additional 50 hours of visual and cognitive control training. The remaining 10 patients were put through the computer games control condition which consisted of 16 commercially available computerized games such as visuospatial puzzle games and clue-gathering mystery games. To assess improvement in cognitive functions, all patients went through a series of neuropsychological assessment based on the MATRICS-recommended measures at baseline, immediately after training, and at the 6-month follow-up. The assessment domains were grouped as: speed of processing, verbal working memory, verbal learning and memory, cognitive control, and global cognition (a composite score of all the measures).

Comparison of patients' cognitive performance showed that the patients in the cognitive training group significantly improved in global cognition, speed of processing, verbal memory and learning, and cognitive control compared to the patients in the control condition. From baseline to the 6-month follow-up, the two groups differed significantly on the verbal learning and memory domain, and cognitive control domain, suggesting the durability of these training effects in these two cognitive domains. To examine the dosing effect, the patients in the cognitive training group were separated into those who had

undergone 50 hours of cognitive training and those who had undergone 100 hours of cognitive training. These two groups and the control group were then compared on their cognitive performances assessed at baseline and at the 6-months follow-up. The results showed that the patients who received 100 hours or 50 hours of cognitive training made significantly greater gains on verbal memory and learning, and cognitive control compared to the control group. For global cognition and speed of processing, only the patients who received 100 hours of cognitive training showed significant cognitive gains compared to the control group. Thus the results from this study showed that the patients who received the neuroplasticity-based computerized cognitive training program experienced significant cognitive gains. Furthermore these cognitive gains were durable at the 6-month follow-up assessment, and the more intense remediation intervention produced greater cognitive benefits for the patients (specifically for speed of processing and a global measure of cognition). Thus the results obtained from Kurtz el al. (2007) and Fisher et al. (2010) have established that computer-assisted cognitive remediation programs can be effective in producing durable improvements in the cognitive functions of schizophrenia patients.

Translating Improvement in Cognitive Functions into Functional Improvement

While it is important to establish that cognitive rehabilitation is effective in improving the cognitive domains being targeted, it is equally important to investigate whether these training effects are generalizable. For schizophrenia patients, this issue is pertinent to whether cognitive rehabilitation is able to

generalize from the gains in specific cognitive skills to a more general improvement in functional outcome –especially given the relationship between cognitive function and functional outcomes (e.g., Green et al. (2000)).

The generalizability (or in other words, the transfer of specific training effects to other untrained tasks or domains) of cognitive rehabilitation is widely researched and discussed in many fields, not just within the field of schizophrenia. A study by Owen et al. (2010) attempted to look at the generalizability of such training programs to untrained tasks among healthy adults. A total of 11,430 participants were recruited and randomly assigned to one of three groups. One group underwent a highly-focused computer-based cognitive training program targeting reasoning, planning, and problem-solving abilities. Another group underwent a general cognitive training program available from a commercial brain training device that targeted a broad range of cognitive functions while a third (control) group experienced an equal amount of computer exposure time but without cognitive training. To assess the generalization of training, a broad spectrum neuropsychological battery was administered pre- and post-training which included the measurement of reasoning skill, verbal short-term memory, spatial working memory, and paired-associates learning. Pre- and post-training comparison of the performance on trained tasks showed improvements in their respective training task for the participants in the two groups that went through different cognitive training paradigms. However, comparison of the pre- and post-training performance on the neuropsychological battery showed no significant improvement in scores between all three groups other than a general practice

effect. Thus Owen et al. (2010) concluded that there was no generalization of cognitive improvement from the trained task to an untrained task, suggesting the ineffectiveness of such cognitive training in translating gains in skills beyond the training perimeter among healthy participants.

Early research findings on the generalization effects of cognitive training for schizophrenia patients have reached essentially the same conclusion. Bellack, Blanchard, Murphy, and Podell (1996) recruited 27 schizophrenia patients and administered the Wisconsin Card Sorting Test (WCST) and the Modified Vygotsky Concept Formation Test (VCFT) to all of them. The patients were then randomly assigned into two groups whereby they either received further training on the WCST or the VCFT. At the end of the training, the patients were administered the other test on which they had not been further trained to see if there was any transfer of acquired skills (i.e., the patients trained on the WCST were later administered the VCFT and vice versa for the patients trained on the VCFT). While all patients showed improvement in the test on which they were trained, there was no evidence for the transfer of training related improvements to the other untrained test despite the apparent similarity of cognitive functions required in both tests. This result, similar to that of Owen et al. (2010) suggests that training effects are limited to the specific skills targeted by the training, and that such improvements do not readily transfer to untrained tasks (even if they appear to be very similar in the skills required to perform them).

However Bellack, Weinhardt, Gold, and Gearon (2001) suggested that a methodological issue could have prevented a transfer of training effects to the untrained task in the study by Bellack et al. (1996). Bellack et al. (2001) argued that any transfer of training to the untrained task would show up as a much smaller improvement in the untrained task compared to the improvement seen on the trained task. Therefore to detect any generalization of the training effect, the improvement on the trained task must be large enough, and the test of improvement sensitive enough. When studies like Bellack et al. (1996) showed no generalization of training effect, it could therefore be possible that there was actually a generalization of training but that the effect was undetected (i.e., the untrained task was affected by a smaller generalization effect caused by the trained task). To test this hypothesis, Bellack et al. (2001) conducted a study similar to Bellack et al. (1996), in which instead of the VCFT, the Halstead Category Test (CAT) was employed. Similar procedures were followed whereby the recruited schizophrenia patients were first assessed on the WCST and the CAT. Then they were randomized to receive either training on the WCST or the CAT which was then followed by the administration of the other untrained test after the training session. Rather than assessing all patients on the generalization of trained skills, Bellack et al. (2001) argued that any transfer of training would only be noticeable among patients who benefitted the most from the training sessions and who had shown substantial improvement on the trained task. Therefore, only those who showed at least 10% improvement on the trained test were examined for any generalization effect. Using such a criterion, Bellack et al. (2001) found a significant transfer of skill in the patients trained

on the WCST who now also showed a significant reduction in errors on the pre-to-post CAT performance comparison. The same pattern of transfer was also found in those patients who were trained on the CAT and assessed for generalization with the WCST.

Bellack et al. (2001) sheds some light on why some studies had failed to detect generalization of training received from cognitive rehabilitation onto untrained task. Further support for the generalizability of cognitive training effects to the untrained task was found via carefully designed video games that encouraged the adoption of flexibility in the use of different strategies. Basak, Boot, Voss, and Kramer (2008) recruited 40 healthy older (65 years and above) novice video game players in a study that investigated the efficacy of cognitive training using a real-time strategy video game training task. The participants were randomized into two groups: one group underwent training on the video game, and the other (control) group received no exposure to the video game training. The video game was an off-the-shelf game called Rise of Nation: Gold Edition (RON) in which a player had to build new cities, improve city infrastructure and expand one's national border. Multiple strategies were available to players to reach the goal of the game which was to either control 70% of the land, destroy the other civilisations, or build a majority of "Wonders of the World". Thus RON was a strategic based video game that demanded players to be mentally flexible as they had to continuously assess, monitor, and plan strategies to increase their resources and assets. Training of the video game was spread out into 15 1.5 hours sessions over four to five weeks which amounted to a total of 23.5 hours of training. To measure any

transfer of cognitive skills acquired from the training on the video game to untrained domains, a battery of general cognitive assessment was conducted pre-, during-, and post-training (first week of study, fourth week of study, and seventh or eighth week of study respectively). The cognitive assessment included executive control tasks like Operation span, Task switching, Raven's Advanced Progressive Matrices, Stopping task, N-Back task and Visual short term memory (VSTM). Visuospatial attentional skill was also assessed with tasks that measured attentional blink, mental rotation, functional field of view, and enumeration.

Performance on the video game improved post-training with faster completion time to reach the goal of the game, and higher scores achieved with more Wonders of the World being built during the game. This showed that the training was effective in improving RON game performance. To assess for generalization of training effects to the untrained task, performance on the cognitive assessment tests across sessions was compared between the two groups of participants. Of all the executive control tasks assessed, transfer of training was detected for Task switching, N-Back task, VSTM, and Raven's Advanced Progressive Matrices with participants who had undergone video game training outperforming the control participants. Transfer of training was also detected for the mental rotation task in the visuospatial attentional domain. Basak et al. (2008) thus showed that generalization of cognitive training effect to the untrained tasks was possible. In addition, Basak et al. (2008) also echoed the explanation by Bellack et al. (2001) on how the transfer of training onto untrained task would be more prominent with larger

improvement on trained task. Basak et al. (2008) showed that improvements in performance on the video game were significantly correlated with improvements in performance on the untrained tasks. In addition, Basak et al. (2008) also offered another explanation why earlier studies had not been successful in producing transfer effects. To have larger transfer effect, Basak et al. (2008) suggested that the training task should be more complex. The reason why transfer effects were not found in earlier studies, they argued, could have been because the training protocol used in these earlier studies was simpler and did not involve training in the flexible use of different strategies as was encouraged among their participants during RON training.

Thus evidence supporting the generalizability of cognitive rehabilitation training effect onto untrained task provides hope that cognitive rehabilitation's training effects on cognition could translate into functional improvement in schizophrenia patient. McGurk, Twamley, Sitzer, McHugo, and Mueser (2007) reviewed 26 studies that used either computerized or non-computerized cognitive rehabilitation methods for evidence of improved cognition translating into functional gains among the schizophrenia population. This meta-analysis showed that cognitive rehabilitation improved cognitive functioning in schizophrenia patients with effect sizes in the medium range (an average effect size of 0.41). A similar result was also found for improvements in psychosocial functioning, with an average effect size of 0.35, just slightly below that for cognitive functioning. This suggests that cognitive rehabilitation can have a positive effect on functional outcome of schizophrenia patients. It also supports the argument by Bellack et al. (2001)

that performance gains for untrained tasks (in this case psychosocial functioning) are smaller compared to the gains on trained tasks. Unlike the effect size for cognitive functioning, McGurk et al. (2007) found that the effect size for psychosocial functioning was not as consistent across the different studies. Further investigation showed that the inclusion of other types of rehabilitation program such as psychiatric rehabilitation moderated the effect of cognitive rehabilitation programs that also incorporated psychiatric rehabilitation (which had more impact on functional outcome than those programs that did not integrate psychiatric rehabilitation within the program). Such integrated programs would be likely more complex and more demanding on the patients as the skills trained would be more varied, and hence could also be taken as support for Basak et al. (2008)'s suggestion that transfer effects should be more evident following more complex training interventions. McGurk et al. (2007) also found that programs with strategy coaching (more complex training) seemed to be more effective in improving functional outcomes compared to those that focused on only-drill-and-practice. Other findings from their meta-analysis included a significant but very small effect size on cognitive rehabilitation and schizophrenia symptoms, which is perhaps consistent with the earlier conclusion drawn in previous section of this thesis about the relative independence of symptoms and cognitive functions in schizophrenia patients. Older schizophrenia patients were also found to benefit more from the cognitive rehabilitation programs when compared to younger patients.

A more recent meta-analysis by Wykes, Huddy, Cellard, McGurk, and Czobor (2011) which included a larger number of studies and patients largely concurred with the results of McGurk et al. (2007). Their meta-analysis showed a similar positive effect of cognitive rehabilitation on global cognition, and that cognitive rehabilitation programs that incorporated adjunctive psychiatric rehabilitation had significantly larger effects on functional outcome. Wykes et al. (2011) also found that all schizophrenia patients, regardless of their symptom severity, benefited from cognitive rehabilitation even if the effect size was smaller for those with more severe symptoms. Wykes et al. (2011) found that age did not have any moderating effect which differed from the conclusion made by McGurk et al. (2007). This may be because Wykes et al. (2011) included observations from studies which reported older schizophrenia patients as having poorer treatment outcomes - these observations were different from McGurk et al. (2007) who found older schizophrenia patients benefitted more from cognitive rehabilitation. These conflicting conclusions suggest that the effect of age on cognitive rehabilitation outcome warrants further investigation.

Thus there is clear evidence then that increases in cognitive functions from cognitive rehabilitation effects can translate into better functional outcomes, especially when other types of rehabilitation programs like psychiatric rehabilitation or psychosocial rehabilitation are integrated alongside cognitive rehabilitation to result in more complex and varied training regimens.

Despite the evidence for positive effects of cognitive rehabilitation programs, the cost-benefit analysis of such programs must be carefully considered. Cognitive rehabilitation is a long-term, labour-intensive, and costly enterprise with training sessions lasting from 20 minutes to 5 hours over programs spanning up to six months (Twamley et al., 2003). A three-month cognitive remediation program can cost US$700 per participant, which can be expensive for patients who may later experience difficulties finding employment or staying employed (Wykes, 2010). The push to develop computer-assisted cognitive rehabilitation programs may also be a realisation of the labour-intensiveness of such programs. In Singapore, the Ministry of Health concluded that mental disorders are a top five contributor to the total burden of diseases (contributing 11.5% of the total disease and injury burden in Singapore, of which schizophrenia alone contributed 2.6%). Among the age group of 15 – 44 years (a critical period when one's career and personal life dramatically develops), schizophrenia was the third leading specific cause of burden in both men and women (Ministry of Health Singapore, 2004). Thus successful rehabilitation of schizophrenia patients will be beneficial to the patients and also to the society.

For a schizophrenia patient in Singapore, inpatient and outpatient medical treatment can be obtained from psychiatric services within both the public and private hospitals, with one of the public hospitals dedicated specifically to mental healthcare conditions (Chong, 2007; Institute of Mental Health, 2009). From observations of one of the psychiatric units in a public hospital (i.e., National University Hospital), a multi-disciplinary team approach is adopted

in the care of psychiatric patients. Other than the doctors and nurses that form the core team who manage the schizophrenia patients, regular services are also provided by occupational therapists, psychologists, pharmacists, and social workers. Schizophrenia patients warded at the National University Hospital have access to daily occupational therapy activities such as the teaching of simple cooking skills, and art and craft sessions. Regular group therapy sessions targeting psychological health (i.e., stress management) are also conducted by the occupational therapists. Psychologist inpatient services involve neuropsychological assessments or personality and mood assessments as well as counselling services. Social workers are usually tasked to resolve financial matters or discharge related issues. After being discharged by the hospital, schizophrenia patients are regularly followed up by doctors for the monitoring of illness and medication. Sometimes, patients may be referred to aftercare centres or halfway homes. Referrals to aftercare services are usually based on clinical judgement about whether the patient can benefit from such services, and the choice of aftercare centres or halfway homes is sometimes limited by availability and transport convenience. In terms of cognitive rehabilitation, there seems to be few if any of such services provided as part of inpatient care and the situation is similar for outpatient aftercare centres (R.C.M., Ho, personal communication, July 27, 2011). The majority of rehabilitation programs are instead focused on psychosocial skill or vocational training (Singapore Association for Mental Health, n.d.; Tan, 2011).

From these observations there seems to be ample opportunities and needs for the introduction and development of cognitive rehabilitation programs in

Singapore. At the early stage of adopting such programs, Singapore is in an ideal position of being able to learn from other countries which have already incorporated cognitive rehabilitation into their healthcare systems, and has the potential to adopt the best practice approaches. For example, it has been suggested that individual characteristics have an impact on rehabilitation outcome (Wykes et al., 2011), and besides looking at the efficacy of cognitive rehabilitation programs, an equally important factor will be optimizing how patients are selected for such programs.

In the next chapter the discussion will focus on the Dynamic Assessment paradigm, whose proponents argue can help make resource utilisation for cognitive rehabilitation more efficient by ensuring a better fit between patient's needs and the type of cognitive rehabilitation being offered. Dynamic Assessment is sensitive to individual's characteristics, and specifically measures the Learning Potential of each schizophrenia patient. Learning Potential is a possible selection criterion for choosing who is suitable for attending a rehabilitation program, and as such Dynamic Assessment may be an important tool in determining the likely efficacy of heavily resource-intensive cognitive rehabilitation programs.

Chapter 3: Dynamic Assessment and the Assessment of Learning Potential

The foregoing discussion indicates that cognitive deficits are related to functional outcomes of schizophrenia patients. Therefore, the use of cognitive rehabilitation to address cognitive deficits is a natural step to take when the goal is to improve patients' functional level. In this chapter we will review Dynamic Assessment (DA), whose proponents believe that it can improve the success rate of rehabilitation efforts with schizophrenia patients by assessing their Learning Potential.

DA is defined as an assessment of "thinking, perception, learning, and problem solving by an active teaching process aimed at modifying cognitive functioning" (Tzuriel, 2000, p. 386). It aims to qualify and quantify Learning Potential of a person during the acquisition of cognitive skills. A general DA paradigm consists of a pre-test, intervention, and post-test scenario. The intervention is the quintessential part of DA and allows the examiner to evaluate the examinee's Learning Potential, specific deficient functions, and possible mediational strategies that may be useful for the examinee to utilize.

Historical Roots of Dynamic Assessment

Dynamic assessment (DA) owes its theoretical origins to Vygotsky and Feuerstein. Vygotsky's sociocultural theory posits that both the interaction between a child and his/her natural environment, as well as the social interaction between a child and an adult or peer are important for the child's cognitive development. A child's cognitive development can be viewed at two

different levels. A child's *actual* level is the result of cognitive operations achieved through the completion of various development phases. A child's *potential* level is made up of cognitive operations that are still evolving and their developmental path can be modified through intentional mediation of these cognitive operations (Vygotsky, 1978). The quality of these environmental and social interactions will determine what a child can achieve cognitively and also what he/she can potentially achieve in future.

Vygotsky's concept of the zone of proximal development (ZPD) from his sociocultural theory has a particular influence on the evolution of DA. Vygotsky explained the concept of ZPD as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p. 86). Vygotsky gave an example of two children of the same chronological age and mental age to illustrate his point (refer to *Figure 1*). In this example, two children with the same chronological age and same mental development level, were given assistance to solve a problem that was at a level higher than their mental development level. During the time when assistance was given, one child was seen to make use of the assistance better to deal with the problem compared to the other child. The child who could learn to master this higher level problem was considered to have a greater ZPD compared to the other child. This example showed that each child's potential for development was different despite the similar manifested mental age performance. Vygotsky thus argued that an individual's actual level of development and

his/her potential for development were two different entities (Vygotsky, 1978). Hence it is not just what one is, but what one has the potential to become that is important, and this concept of Learning Potential in Vygotsky's work has propelled the field of DA.

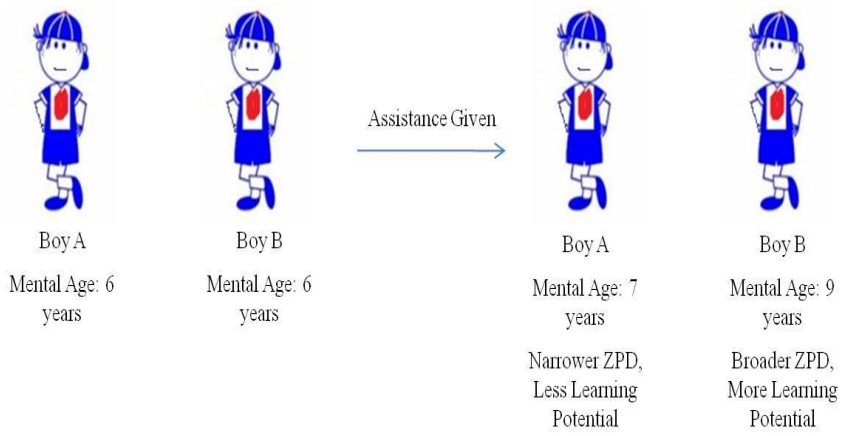


Figure 1. Vygotsky's Zone of Proximal Development (ZPD). Two children with same mental age showed different ZPD after assistance was given to them while solving problems beyond the level of their mental age. Boy B who was able to solve more difficult problems with assistance had broader ZPD compared to Boy A who was not able to utilise the assistance to solve the problems.

According to Feuerstein's structural cognitive modifiability theory, individuals are able to change their cognitive functions and adapt their functioning to changing demands. Cognitive modifiability can be achieved through mediated learning experiences (MLE). For example, in children MLE interactions could be processes in which "parents or substitute adults interpose themselves between a set of stimuli and the child and modify the stimuli for the developing child" (Tzuriel, 2001, p. 458). To help children learn about the world or to solve a problem, parents or any adults can mediate the situation by offering different strategies like drawing the child's attention to certain stimuli,

or by providing meanings to the child about the world or the problem. A change in the child's cognitive functions or his/her adaptability is induced when the MLE processes are internalized by the child. According to the proponents of DA, the MLE interactions during the assessment session help the examiner to facilitate the examinee's learning processes, to identify any possible cognitive deficits, and to provide intervention recommendations. Thus, Feuerstein's theory of cognitive modifiability departs from Vygotsky' ZPD in the sense that it is about changing existing cognitive structures rather than measuring Learning Potential. Cognitive change is assessed by looking at how the examinee generalises the learning acquired during these performances.

Reasons behind Increased Interest in Dynamic Assessment

Interest in DA is traceable to psychologists working in the educational setting, specifically psychologists who conduct intelligence assessment for children. These psychologists were becoming more aware of the deficiency inherent in standard assessment methods, especially when working with minority children and learning disabled children (Tzuriel, 2000). This growing dissatisfaction resulted in a group of psychologists suggesting an alternative form of assessment method now known as DA.

Conventional psychological testing has a very structured methodology. The examiner presents test items (usually following exactly the way as instructed in test manuals) to the examinee and records the examinee’s responses. During these exchanges, the examiner will not make any attempt to intervene, change,

guide or improve the examinee's performance (Tzuriel, 2001). The assessment returns a result that suggests the examinee's level of performance, usually for a certain cognitive ability. There are reasons behind the strict methodology employed for conventional testing. One of them is to allow comparability of test results obtained on different administrations (Lezak, Howieson, & Loring, 2004). However, some psychologists found this testing format (albeit useful) too restrictive and raised several criticisms against it (Haywood & Lidz, 2007).

One reason that psychologists found the conventional testing methodology to be too restrictive was that the test set-up did not capture non-intellectual factors that might have influenced the examinee's performance during the test session (e.g., motivation level, anxiety, frustration, tolerance, self-confidence). In the case of an unmotivated examinee, a structured testing session that did not tolerate encouragement from an examiner would result in the underestimation of an examinee's performance. The result would not be an accurate estimate of the examinee's abilities but a result influenced by his/her lack of motivation in that setting (Tzuriel, 2001).

Another criticism against conventional testing was the poverty of information available about the examinee's learning processes and latent cognitive functions from the assessment. The conventional test result would show the level of the examinee's acquired and developed abilities but not their latent abilities yet to be developed, nor ways in which these abilities might be developed (Sternberg & Grigorenko, 2002). For example, conventional

assessment might show an examinee's deficient cognitive functions but would offer few insights as to how remedial strategies could be taught to the examinee. As stated by Tzuriel (2001, p. 3), conventional testing emphasized "the psychometric properties of the individual's functioning, whereas the learning processes that are required to bring about change are ignored".

Psychologists have also suggested that conventional tests can be more prone to cultural bias. Sternberg and Grigorenko (2002) argued that conventional tests favoured by most psychologists have tended to assess skills valued and taught in the Western culture. Examinees who are not from a Western culture would therefore be biased against when subjected to such assessments. Tzuriel (2001) also used the assessment of children to illustrate this criticism against conventional tests. He argued that conventional assessment tended to create biases against less privileged children or children from minority racial groups and as a result a large proportion of them were enrolled in special-needs programs. He suggested that such children were failing these tests because of a lack of learning opportunities, or cultural differences, rather than problems with learning abilities. This argument was supported by Dwairy (2004) who showed that some students were wrongly classified as having learning disability based on the conventional assessment method. Out of 48 fourth grade students who met the criteria of learning disability after being assessed conventionally, Dwairy showed that 14 of them (29.16%) were able to learn a new language (Arabic) after going through a special long term program. Supporters of conventional testing might argue that the use of non-verbal tests could circumvent this problem, but studies had suggested that conventional

non-verbal tests could be just as culturally biased as conventional verbal tests (Rosselli & Ardila, 2003).

The proponents of DA suggest that the pre-test – intervention – post-test assessment paradigm can address some of the shortfalls of conventional testing. By embedding teaching instructions within the intervention, DA overcomes the possible biases of the conventional version of the test. This is because all the necessary information for mastery of the test is provided in the intervention phase. Not only would the DA paradigm overcome such biases, the format would also allow the examiner to assess the examinee's learning processes as he/she tried to learn and apply the information provided during the intervention phase. As Grigorenko and Sternberg (1998, p. 76) explained, "This view of the testing procedure underlies our use of the terms testing of learning potential".

The Different Applications of Dynamic Assessment

Since its development, DA has been used in the clinical setting to help differentiate clinical subgroups from each other. One study attempted to differentiate clinical subtypes of dementia patients from non-dementia elderly persons by comparing how the groups progressed through the dynamically administered Auditory Verbal Learning Test (AVLT). Performance on the dynamically administered AVLT across sessions by elderly participants with dementia was worse than non-dementia elderly participants (Wiedl, Schottke, & Garcia, 2001). Another study attempted to differentiate patients with mild cognitive impairment (MCI) from those with Alzheimer's disease (AD) by

dynamically administrating the Battery of Learning Potential for Assessing Dementia (BEPAD). The results showed that Learning Potential scores were better at discriminating MCI from AD patients compared to using the pre-test scores, which would have only been available from a conventionally administered BEPAD (Fernandez-Ballesteros, Zamarron, & Tarraga, 2005).

The field of occupational therapy has also recognised the applicable value of DA in recent years (Toglia & Cermak, 2009). DA's principle of assessing learning and changed behaviours aids the occupational therapist in their goal of teaching new or compensatory strategies to cope with problems encountered in everyday living. Toglia and Cermak (2009) demonstrated that dynamically administered conventional occupational therapy helped guide therapists when providing interventions to their patients. The dynamic administration of conventional tests (Line Crossing Test, Star Cancellation Test, Picture Scanning Subtest, Object Search Test) that assess unilateral neglect provided opportunities for therapists to observe how strategy and feedback were incorporated into patients' behaviours to help correct unilateral neglect.

DA has also been evaluated in terms of its value in predicting functional outcome of brain injury patients. After patients were grouped on the basis of their dynamically assessed learning abilities during an executive function test (the Wisconsin Card Sorting Test, WCST), multiple regression analysis showed that these learning abilities were more predictive of community reintegration following brain injury than the usual gauge of functional

outcome (i.e., severity of injury) (Uprichard, Kupshik, Pine, & Fletcher, 2009).

DA has also been applied to predict functional outcome of schizophrenia patients. Sergi, Kern, Mintz, and Green (2005) compared DA and conventional assessment in predicting work skill acquisition in schizophrenia patients. The team dynamically administered the WCST to 57 schizophrenia patients such that information about the sorting rules and feedback about trial-to-trial performance was given to the patients during the intervention. Subsequently, the patients were assigned to undergo two work skill training sessions (index card filing and toilet tank assembly). Work skill acquisition was assessed immediately after the training session and at a three-months post-training follow-up. Patients with high Learning Potential (which was calculated from the gain scores obtained from the dynamically administered WCST) were found to acquire the work skills more readily compared to those patients with poorer Learning Potential. Multiple regression analysis showed that while participants' pre-test WCST performance (conventional assessment) explained 13% of the variance in work skill acquisition as assessed immediately after training, gain scores from the dynamically administered WCST were able to explain an additional 15% of the variance. For work skills assessed three months after training, pre-test WCST performance (conventional assessment) explained 6% of the variance while gain scores from the dynamically administered WCST explained an additional 13% of the variance. Thus the dynamically administered WCST had better predictive utility for work skill acquisition compared to conventional assessment.

The foregoing discussion has demonstrated the wide ranging applicability of DA. For example while brain injuries are acquired and tend to improve with time, schizophrenia is considered a neurodevelopmental disorder, yet DA interventions are applied to both brain-injured patients and schizophrenia patients. It will be important to examine whether processes of DA work similarly with different types of patients. There will be more discussion on the efficacy of DA in Chapter 4 and Chapter 5 of this thesis. But first, the concept of Learning Potential is described in greater detail.

Concept of Learning Potential

The development of DA is based on both Vygotsky's ZPD and Feuerstein's structural cognitive modifiability theory. To understand how DA can help assess rehabilitation potential (i.e. the ability to learn new skills) in schizophrenia patients, it is important to first understand the concept of Learning Potential and how patients internalise and generalise rehabilitation efforts. The following discussion will focus on the Learning Potential construct derived from Vygotsky's ZPD.

To understand Learning Potential, Vygotsky's ZPD needs to be operationalized. To do that, examiner provides helpful instructions for a selected test after the test is administered to the examinee. The way the examinee handles the instructions determines how much Learning Potential the examinee has. If he/she makes good use of the instructions and translates that into better performance when the same test is administered again, this

constitutes a better demonstration of Learning Potential compared to someone who is less effective in translating the instructions into improved performance. This highlights the importance of the pre-test – intervention – post-test assessment methodology of the DA paradigm.

Different approaches to conducting DA have been adopted each with their own different names: learning potential assessment, mediated learning, testing the limits, mediated assessment, assisted learning and transfer by graduated prompts among others. Table 1 summarizes the main approaches that have been adopted.

Table 1

Different Approaches used in Dynamic Assessment

Approach	**Design**	**Procedure**
The theory of structural cognitive modifiability	Feuerstein's "Learning Potential Testing Device" test	Test – mediate - test
Learning potential testing	Budoff"s "Test - centred coaching"	Formal pre- and post-test with standardized training / coaching as intervention
Testing via learning and transfer (Graduated prompt)	Uses hints	Pre-test (level-of-performance) – initial mediated learning – static maintenance and transfer testing – mediated maintenance and transfer
Lerntest approach (Learning potential testing)	Learning Potential Tests - German version	(1) pre- and post-test with training as intervention (long term) (2) train – within – test paradigm (short term)

	Learning Potential Test for minority group - Dutch version	Train – within – test paradigm
Testing – the – limits approach	To teach to the limit	Multiple conditions (whereby the amount of verbalization and feedback varies)

Note. Adapted from Sternberg & Grigorenko (2002, p. 24)

Sternberg and Grigorenko (2002) consolidated the methods used in these approaches into two main formats which they called the "sandwich format" and the "cake format". In the sandwich format, instructions about skills measured in the pre-test will be given during the intervention phase. The type and amount of instructions are determined by the purpose of the assessment and the examinee. This can be varied to suit individuals in a one-on-one session while it is usually uniform in group-testing sessions. The cake format is usually adopted for individual testing, in which a graded series of hints are given to the examinee when he/she cannot solve the item correctly. The hints are graded in the sense that the solution will become more and more apparent if the examinee continues to fail the item. In this format, the amount of instructions given will depend on the examinee's performance.

The different approaches to conducting DA result in slight differences in the way that Learning Potential is operationalized and measured. The extent of help provided to the examinee is one way of measuring Learning Potential, and based on such a perspective, Learning Potential could be operationalized as the "number of hints or prompts required to reach a performance criterion

on learning tasks" (Brown & Ferrara, 1985, p. 284; Allal & Ducrey, 2000). Some proponents of DA regard the transfer of control from other-regulation to self-regulation as an important aspect of Learning Potential. To assess this transfer, the minimum amount of help required for an examinee to gain mastery of a task is used as a measurement (Hamers & Resing, 1993, p. 35). To show the examinee's learning responsiveness and modifiability, the change in performance between pre- and post-test assessments can also be measured, and hence Learning Potential is operationalized as the change in these performance scores (Brown & Ferrara, 1985, p. 275; Hamers & Resing, 1993, p. 27). This is also the definition of Learning Potential that is used in this thesis. Despite the different ways Learning Potential is operationalized however, a commonality can be derived from the different interpretations which is that they all reflect the individual's potential for change.

The Intervention Session within the Dynamic Assessment Paradigm

Another important feature of the DA paradigm is the intervention session which is inherent regardless of whether the sandwich format or the cake format is used. The nature of the intervention is determined by whether the examiner is more interested in quantifying change, whereby he/she will most probably use the sandwich format, or if he/she is interested in qualifying change, whereby the cake format will be more suitable for this purpose. The nature of the intervention in the DA paradigm is also determined by whether the DA paradigm is based on Vygotsky's ZPD or on Feuerstein's theory of cognitive modifiability. Based on Feuerstein's theory of cognitive modifiability, the intervention should produce more permanent changes in the

examinee’s abilities by changing existing cognitive structures. Based on Vygotsky’s ZPD, the intervention is designed by the examiner to measure the examinee's cognitive and learning processes as he/she attempts the task set up by the examiner. Therefore, the result of the intervention is transient as its purpose is to show the examinee's learning responsiveness and modifiability. This latter type of DA intervention is the type used in this thesis.

The adoption of the Vygotskian based DA paradigm is useful for clinicians who want to predict how much a schizophrenia patient can benefit from rehabilitation intervention (i.e. the patient’s rehabilitation potential). In this case the clinician needs to quantify the change achieved by the patient through the DA intervention. By examining the change in performance between pre-test and post-test, the clinician can gain insights into the patient’s rehabilitation potential, as the patient’s performance during the assessment process provides an indication as to how the patient will fare in an actual rehabilitation program. The next two chapters examine the claims made by DA proponents: namely, that DA intervention helps assess Learning Potential, and that Learning Potential is a unique construct measured by DA.

Chapter 4: Study 1

As discussed in Chapter 1 and 2, cognitive deficits are often associated with poorer functional outcomes in patients with schizophrenia (Green et al., 2000). Evidence that functional outcomes of schizophrenia patients can be improved with the remediation of cognitive deficits suggests that clinicians should enrol their patients for rehabilitation as part of the treatment plan (Wykes et al., 2011). However clinicians need to be discerning about a patient's readiness for rehabilitation before making such a referral, because (as discussed in Chapter 2) rehabilitation programs are labour- and time-consuming. Referring a patient who is not ready, or referring the patient to a rehabilitation program that does not meet the patient's needs, could result in a waste of valuable resources. Therefore, it would be helpful to identify ways to predict a patient's rehabilitation readiness and rehabilitation potential to ensure the resources needed for the rehabilitation programs are allocated to the most appropriate patients. One potential way to predict rehabilitation potential of schizophrenia patients is the DA of changes in a patient's performance (i.e., Learning Potential) that results from the DA intervention. The focus of this chapter is to more closely further investigate the DA intervention in the context of schizophrenia patients. More specifically, to examine whether, and if so how, the DA intervention brings about any such performance improvements in an executive function task (the Wisconsin Card Sorting Test, WCST), and whether these improvements might be due instead to some other confounding factors such as practice effects.

To date only a few studies have examined the Learning Potential of schizophrenia patients through DA. The earliest study examined whether Learning Potential measured via the dynamically administered WCST could predict future rehabilitation outcome in schizophrenia patients (Wiedl & Wienobst, 1999). Sergi et al. (2005) which was discussed in Chapter 3, compared the usefulness of DA versus conventional assessment in predicting work skill acquisition in schizophrenia patients. Both studies concluded that DA was useful in predicting rehabilitation potential of schizophrenia patients, and hence DA has evident practical applications. However, to really understand more about how the DA intervention gives rise to performance benefits and whether there are limitations in certain patient populations that will limit its predictive value, there is a need to look more closely at the intervention itself. Understanding more precisely how the DA intervention gives rise to performance improvements could highlight ways to enhance such improvements, and also ways to enhance its utility in predicting rehabilitation potential.

Within the DA methodology, changes in performance from before and after the intervention are interpreted as a demonstration of the person's Learning Potential. It is however possible that such changes may be simply due to repeated exposures to the tests (i.e., the so-called "practice effect"). Basso, Bornstein, and Lang (1999) assessed practice effects on commonly used neuropsychological tests. For the WCST there was found to be improvement due to practice even after twelve months since the initial test session. A meta-analysis of fifty studies on tests designed to assess cognitive abilities

suggested that test scores increased by approximately one quarter of a standard deviation due to practice effects (Hausknecht, Halpert, Di Paolo, & Gerrard, 2007). Several reasons including: reduced anxiety, memory of previous responses, actual development of abilities, enhanced test-taking strategies, and regression to the mean, were suggested as possible reasons behind these observed practice effects that resulted in improved scores at subsequent retests. Given the test-retest design of DA, one possibility is that simple practice effects (e.g., familiarization with the nature of the test stimuli) may account for the improvements that follow from the DA intervention. If practice effects can account for a patient's improvement between test and retest, then it weakens the argument made by its proponents that the DA intervention is the mechanism behind the improved performance between test and retest. If that were the case, there would be no need for clinicians to request specifically for DA, as simply repeating the conventional neuropsychological assessment would be sufficient to assess a patient's Learning Potential.

Somewhat surprisingly, advocates of the DA paradigm have not explicitly addressed the issue of practice effects. Improvement in performance at post-test is attributed to the DA intervention and more specifically the nature of and way in which the instructions are given to the examinee (Wiedl & Wienobst, 1999; Grigorenko & Sternberg, 1998). Given that practice effects may be the reason behind the improved performance, it therefore seems premature for supporters of DA to attribute causality to the intervention itself for bringing about any such improvements. The effectiveness of these DA interventions should therefore first be evaluated against appropriate control procedures.

Hence, the purpose of Study 1 was to examine whether the improvement in performance detected in DA sessions was due to the DA intervention or whether it was due to simple practice effects (e.g., prior exposure to the test items) in order to ascertain the efficacy of the DA intervention. If the DA intervention per se resulted in the performance improvements seen in participants at the post-test assessment, these improvements should be demonstrable over-and-above any performance improvements seen in the control participants who experienced a similar degree of WCST exposure but no DA intervention. If the DA intervention merely reflected practice effects then there should be no significant difference between the post-test performances of those participants who had received DA intervention and those who had similar exposure to the WCST. However, if the DA intervention affords a better learning opportunity than merely practising the test in a similar setting, performance should be superior for those who received the DA intervention compared to those who merely practised the test to a similar extent. Therefore, the hypotheses are as follows:

1. Participants who receive the DA intervention (Group DA Intervention) will have better post-test performance compared to those who practised the test items such that their level of exposure to the WCST was similar (Group WCST Intervention).

2. Participants who receive the DA intervention (Group DA Intervention) will have better post-test performance compared to those who have no

WCST-related intervention and instead engage in unrelated reading activities (i.e., reading a journal article or checking their SMS text messages) for the same amount of time as the other interventions (Group No Intervention).

Using Wisconsin Card Sorting Test to Assess Schizophrenia Patients

The Wisconsin Card Sorting Test (WCST) was established as an assessment tool for frontal lobe functions (specifically executive functions) after Milner used it to assess dorsolateral frontal-lobe lesion patients, and showed that these patients had difficulties shifting from one sorting principle to another (Milner, 1963; Stuss et al., 2000). Briefly, in the conventional WCST the examinee has the opportunity to sort test cards into one of four key cards (i.e., categories) without being explicitly told what the sorting rule is. After a certain number of correct sorting responses, the rule will change, and the examinee must adapt their behaviour and begin using a new rule to sort the test cards.

Schizophrenia patients are known to perform more poorly on the WCST compared to normal controls. Patients usually have difficulties finding the correct sorting rules and also have high rates of perseverative errors. These errors are often attributed to cognitive deficits suffered by schizophrenia patients (Prentice, Gold, & Buchanan, 2008; Young, Zakzanis, Campbell, Freyslinger, & Meichenbaum, 2002; Bustini, Stratta, Daneluzzo, Pollice, Prosperini, & Rossi, 1999; Koren et al., 1998), and a number of research studies have attempted to remediate schizophrenia patient's performance deficits on the WCST. For example, Goldberg, Weinberger, Berman, Pliskin

and Podd (1987) provided WCST training to 29 schizophrenia patients. The patients were pre-tested on the WCST before proceeding to complete three more rounds of the WCST in which different types of training and instructions were provided during the WCST administrations. One round of training consisted of the patients being told about the sorting rules. This was followed by another round of training that consisted of the patients being told about the set shifting principles (e.g., that the rule changes without warning). This order of training was presented to half of the participants (14 of them) in reverse order. The last round of training consisted of explicit card-by-card instruction. At the end of the three rounds of training, the WCST was administered again so that pre- to post-training performance comparison could be conducted. Another 15 schizophrenia patients served as a control group, and were administered five rounds of the standard WCST without having been given any training instructions. Comparing the patients' performance on the WCST after each round of training showed that incremental instructions (i.e., telling them about the sorting rules, and the set shifting principles) given to the patients did not help them improve their WCST performance relative to the control group. However, intensive card-by-card prompting did help the patients improve significantly compared to the patients in the control group. These effects were transient however, and once the card-by-card help was withdrawn, the patients' performance dropped back to baseline levels, thus suggesting that schizophrenia patients' WCST performance could not be improved with training.

On the other hand, Vollema, Geurtsen, and van Voorst (1995) found that patients' WCST performance improved when the test procedures were explained to them. Two groups of schizophrenia patients were recruited to go through training on the WCST. Using similar training paradigm as Goldberg et al. (1987), the patients underwent five rounds of the WCST, but instead of differential training instructions being provided for the second, third and fourth rounds of the WCST (as in Goldberg et al., (1987)), training was provided just before the third round of the WCST whereby the sorting rules and the set shifting principles were taught to the patients. For one of the groups, monetary reinforcement was also provided during the training (i.e., the patients would receive 25 cents for every correct response). A control group of schizophrenia patients was also recruited to undergo five rounds of the WCST but no training or monetary incentive was provided. Comparing the patients' WCST performance after training, patients who had undergone the training, including those who also received monetary reinforcement, showed better performance in the subsequent rounds of the WCST (third, fourth and five round of the WCST) compared to the control group. When the WCST was re-administered to all the patients two weeks later, the group of patients who had received the training, but not the group who had received the training and monetary reinforcement, showed a sustained improvement in WCST performance. Thus, attempts to improve schizophrenia patients' WCST performance have produced mixed results.

A further complication is that not all schizophrenia patients perform poorly on the WCST: some patients performed within the normal range (Stratta, Arduini,

Daneluzzo, Rinaldi, di Genova, & Rossi, 2003; Wiedl, 1999). Stratta et al. (2003) administered the conventional WCST to 154 schizophrenia patients and found that 98 patients had impaired WCST performance (i.e., only 0-3 categories achieved), while 56 patients had normal or only mildly impaired WCST performance (i.e., completion of at least four categories). Wiedl (1999) administered the conventional WCST to 56 schizophrenia patients before instructing them about how to perform the test and then retesting them with the conventional WCST after this training. Even before any training was given, it was found that 21 of the patients were able to achieve a score of 43 or more on the Total Correct Response measure at pre-intervention assessment (i.e., within the normal range of WCST performance). Taken together, these research studies suggest that poor WCST performance is not universal among schizophrenia patients, and that some patients' ability to learn from WCST training procedures also varies. Wiedl (1999) suggested that a schizophrenia patients' initial level of WCST performance in addition to their varying response to the WCST training, might also be a reflection of their Learning Potential, and hence could then act as a proxy for their rehabilitation readiness.

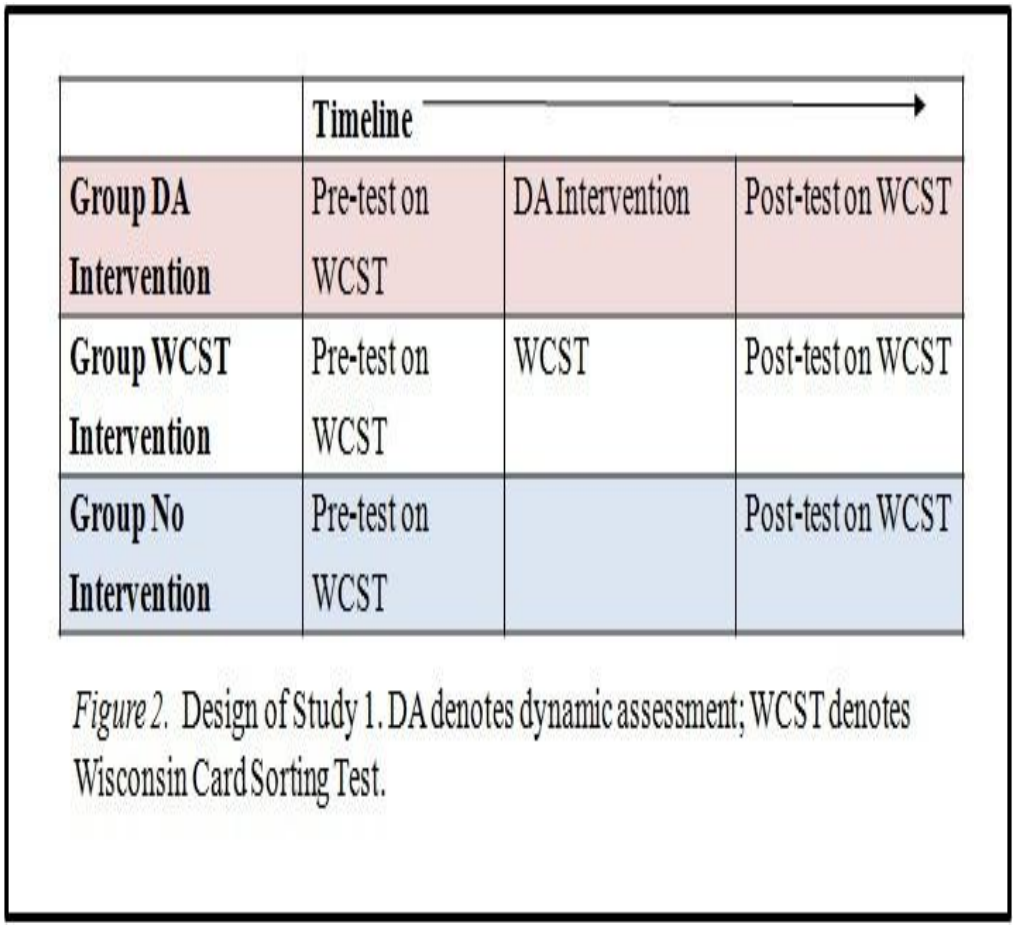
Hence, DA proponents such as Wiedl (1999) have suggested identifying schizophrenia patients who are suitable for rehabilitation programs on the basis of their initial level of WCST performance, as well as their response to the DA intervention WCST training. The proposed groups (i.e., WCST "strong-learners" or "poor-learners") would have implications for their responsiveness to behavioural treatments (Wiedl, 1999). Those who were grouped as "strong-learners" after being dynamically administered WCST

were argued to have better rehabilitation potential whereas those grouped as "poor-learners" after being dynamically administered WCST were seen to have poorer rehabilitation potential or who were more suitable for rehabilitation programs with simpler teaching strategies (i.e., those programs that involved teaching the use of cued cards to enhance memory rather than teaching mnemonic strategies to improve memory ability). Since then, this DA version of the WCST developed by Wiedl (1999) has been used in several studies on schizophrenia patients (Wiedl, Wienobst, Schottke, Green, & Nuechterlein, 2001; Woonings, Appelo, Kluiter, Slooff, & van den Bosch, 2002; Kurtz & Wexler, 2006; Choi & Kurtz, 2009). Thus, the dynamic version of the WCST was selected for the present study's investigation of DA intervention due to its existing use in the DA literature.

The Design of Study 1

To ascertain the efficacy of the DA intervention, different levels of exposure to WCST were arranged for the different groups of schizophrenia patients who were recruited for this study. Thus participants were randomly assigned to one of the three groups that differed only during the intervention phase of the study: 1) Group DA Intervention (who received training on the WCST according to a standard DA protocol (Wiedl & Wienobst, 1999); 2) Group WCST Intervention (who were administered another practice of the WCST); 3) Group No Intervention (who served as the control group and received no additional exposure to the WCST during the intervention phase but who instead engaged in reading activities). All three groups were administered the WCST twice via the conventional method (i.e., before and after the

intervention phase) to assess their pre- and post-test performances. *Figure 2* summarizes the design of Study 1.



	Timeline →		
Group DA Intervention	Pre-test on WCST	DA Intervention	Post-test on WCST
Group WCST Intervention	Pre-test on WCST	WCST	Post-test on WCST
Group No Intervention	Pre-test on WCST		Post-test on WCST

Figure 2. Design of Study 1. DA denotes dynamic assessment; WCST denotes Wisconsin Card Sorting Test.

During the intervention phase, Group DA Intervention would be exposed to the WCST as part of their DA training, while Group WCST Intervention would be exposed to the WCST through another round of the conventional WCST administration. Practice effects could be ascertained in two ways: (i) by comparing the post-intervention assessment performance of Group WCST Intervention with the post-intervention assessment performance of Group No Intervention (i.e., the practice effects arising from increased exposure to the WCST); and (ii) by comparing the pre-intervention assessment performance

with the post-intervention assessment performance in Group No Intervention (i.e., the practice effects arising from re-test familiarity of the test stimuli and procedures). Furthermore, if the DA intervention offers more than a simple practice effect, the post-intervention assessment performance for those in Group DA Intervention should be greater than the post-intervention assessment performance for those in Group WCST Intervention.

Participants

Recruitment for the study was continuous over a 2-year period. Fifty patients diagnosed with schizophrenia or schizoaffective disorder were recruited from the National University Hospital and the Institute of Mental Health upon recommendation by collaborating psychiatrists who followed the ICD-10 or DSM-IV-TR criteria for diagnosis (depending on the training background and preference of these collaborating psychiatrists). Informed consent was obtained from the patients prior to commencement of the study, and the study protocol was approved by the local ethics committee (DSRB). Potential patients with traumatic brain injury, known substance abuse, mental retardation, learning disability and lack of proficiency in English were not recruited. All patients were medicated at the time of study and their dosage, demographics and clinical characteristics were matched as much as possible (none of which were found from a one-way *ANOVA* to differ significantly ($p > .05$) between groups), and are described in Table 2.

Table 2
Demographics and Clinical Characteristics of Participants

			Mean (SD)					
Group	**Age**	**Education (years)**	**Medication Dosage[a] (mg/day)**	**PANSS[b] Positive**	**PANSS[c] Negative**	**PANSS[d] General**	**PANSS[e] Total**	**WASI[f]**
DA Intervention (n = 18; Male = 5)	32.94 (7.84)	13.17 (2.28)	232.74 (234.25)	9.17 (2.30)	9.39 (2.87)	18.72 (2.68)	37.28 (4.51)	100.44 (13.73)
WCST Intervention (n = 14; Male = 7)	34.85 (11.42)	11.38 (3.75)	221.43 (177.64)	8.77 (2.86)	8.85 (2.76)	18.92 (3.01)	36.54 (5.32)	90.85 (12.86)
No Intervention (n = 18; Male = 5)	36.56 (11.26)	11.83 (2.28)	306.27 (160.87)	8.78 (1.67)	10.06 (3.83)	20.94 (4.70)	39.78 (8.88)	93.83 (9.96)
***F* value[g]**	0.58	1.76	0.92	0.16	0.54	1.99	1.07	2.25
***P* value[g]**	.57	.18	.41	.86	.59	.15	.35	.12

Note. SD = Standard deviation; PANSS = Positive and Negative Syndrome Scale; WASI = Wechsler Abbreviated Scale of Intelligence. DA = Dynamic assessment; WCST = Wisconsin Card Sorting Test

[a]The dosage has been converted to reflect chlorpromazine equivalence.

[b]Maximum PANSS Positive Scale score is 49, minimum is 7.

[c]Maximum PANSS Negative Scale score is 49, minimum is 7.

[d]Maximum PANSS General Psychopathology Scale score is 112, minimum is 16.

[e]Maximum PANSS Total score is 200, minimum is 30.

[f]The scores are WASI Full IQ scores. All three groups mean IQ scores are in the normal range.

[g]One-way *ANOVA* showed no significant difference between groups for all demographics and clinical characteristics.

Materials

The Wisconsin Card Sorting Test (WCST)

The Wisconsin Card Sorting Test (WCST) is a popular test used to assess executive functions and mental flexibility (Kongs, Thompson, Iverson, & Heaton, 2000). While the original WCST requires the participant to sort 128 test cards, a 64-card abbreviated form of the standard WCST is also available. The computerized version of this 64-card abbreviated WCST (WCST-64) was used in this study.

The WCST-64 consisted of 64 test cards which the participant was required to sort into categories by selecting one of four key cards (i.e., those cards that are on the top row which remained in the same position throughout the session – please refer to *Figure 3*). For the WCST-64 computerized version, participants were required to press the number tab that corresponded to the key card to choose into which category the test card should be sorted (i.e., the number tab "1" for the first key card starting from the left side of the screen, "2" for the second key card, "3" for the third key card, and "4" for the fourth key card). When using the standard computerized method, the sorting rules (i.e., colour, shape, or number) were not revealed but left to the participants to discover by feedback. The feedback ("RIGHT" or "WRONG") would appear in the centre of the screen. Participants needed to maintain the same sorting rule for 10 consecutive successful sorts, after which the rule changed (e.g., 10 consecutive "RIGHT" colour sorts before the rule changed to shape). If an erroneous sort was made in the middle of consecutive correct sorts (e.g., if after only six consecutive correct sorts, there followed a seventh incorrect sort), the original

sorting rule would remain in place until a further new set of 10 consecutive correct sorts were made, after which the sorting rule would change. The change in sorting rule was not announced explicitly, and completion of a set of 10 consecutive correct sorts was considered as the completion of a category. The session ended when all 64 test cards had been administered. In line with the standard protocol, the WCST-64 was not timed and the participants were allowed to complete the test in their own time (in practice though, all participants took between 10 and 15 minutes to complete the WCST-64). *Figure 3* is a schematic representation of the WCST, and shows an example in which one card is sorted.

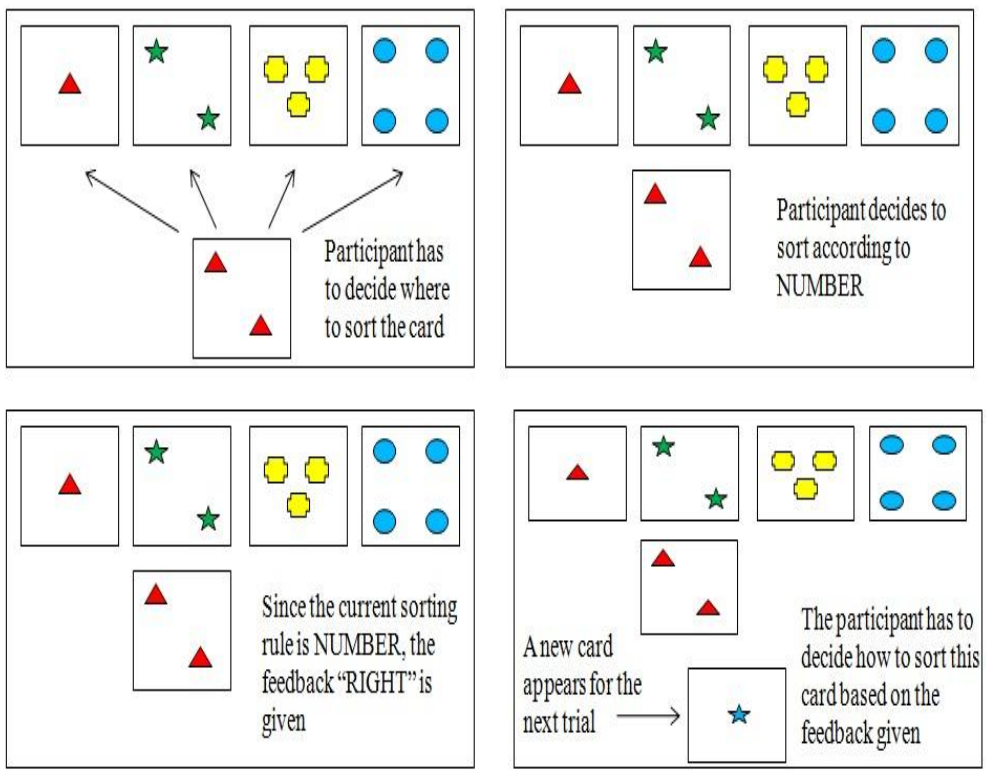


Figure 3. A representation of the Wisconsin Card Sorting Test (WCST). The four cards on the top row are the key cards participants have to sort to. In the computerized version, the key cards are represented by the number tabs "1", "2", "3", and "4" starting from the single red triangle key card on the top left corner. Participants just need to press the corresponding number tab to indicate which key card they are sorting to.

Several measures can be used to analyse performance on the WCST. A typical overall measure is the Total Correct Responses (TCR) score. The TCR score reflects the number of correct responses a participant is able to perform throughout the whole session. Finer grained measures of the WCST focus on specific aspects such as perseverative behaviour which is defined as a pattern of persistent responses. These could be correct responses of repeated sorting to the correct sorting rule, errors made by sorting according to the previously correct sorting rule which has now been changed to another sorting rule, or errors made by sorting to the other incorrect sorting rule. The Perseverative Errors (PE) measure reflects a participant's persistent tendency to sort according to the wrong rule, while the Perseverative Responses (PR) measure reflects all perseverative responses made by the participant (which can be persverative responses that may or may not match the presently correct sorting rule). The Nonperseverative Errors (NPE) measure collates all incorrect non-perseverative errors made by the participant during the session. The Categories Completed measure records the number of categories the participant is able to achieve throughout the session (i.e., the number of sets of 10 consecutive correct sorts that are made according to a correct sorting rule), and the Trials to First Category measure records the number of sorts since the beginning of the test that the participant has made in order to complete the first category. The Conceptual Level Responses measure records all consecutive correct responses that occurred at least three times in a row, while the Failure to Maintain Set measure is the number of times a participant makes five or

more consecutive correct sorts before then making an erroneous response before completing the category (Kongs et al., 2000).

It should be apparent therefore from these descriptions of the various measures that many of these WCST measures are inter-related and not mutually exclusive. The TCR measure can be considered an overall measure of the WCST performance, and knowing either performance on the PE measure or the NPE measure should indicate whether performance is more affected by perserverative or non-perseverative errors. The PR measure is related to the PE measure and the Categories Completed measure. The Categories Completed measure is related to the TCR measure, and comparing the Categories Completed measure and the TCR measure can indicate the Conceptual Level Responses and the Failure to Maintain Set measures. Analysing so many different but related performance measures would potentially cause Type I false positive errors (due to the problems of multiple comparisons, and because they are inter-related, Bonferroni corrections for multiple comparisons would likely cause problems in terms of Type II false negative errors). Thus the TCR measure was adopted as the first level overall analysis, and if significant differences were detected, then a second level of analyses would be conducted on the PE and NPE measures to understand the role of perseverative and non-perseverative errors on the performance differences evident in the TCR measure. Due to the inter-relatedness of these measures and the *a priori* rationale of this two level approach to the analysis, the decision was made to not correct for multiple tests (i.e., α should remain at $p < .05$).

Wechsler Abbreviated Scale of Intelligence (WASI)

The Wechsler Abbreviated Scale of Intelligence (WASI) was used to estimate the intellectual functioning capabilities of the participants. The WASI is a short measure of general intellectual functioning consisting of four subtests: Vocabulary, Block Design, Similarities, and Matrix Reasoning. The subtest Vocabulary assesses the participants' crystallized intelligence and general intelligence through their expressive vocabulary. The Block Design subtest measures perceptual organization and general intelligence by asking participants to replicate two-dimensional geometric patterns with colour cubes. The Block Design subtest is a time limited task with special bonus for completing the task quickly. The Similarities subtest examines the participants' abilities to perform abstract reasoning verbally by asking them to explain commonalities between two objects or concepts. The Matrix Reasoning subtest measures nonverbal fluid reasoning during which the participants attempt to select the missing pattern that completes a grid array from five possible choices. Age-corrected Full Scale IQ scores are then calculated from participants' scores on all four of the subtests. (The Psychological Corporation, 1999)

The Positive and Negative Syndrome Scale (PANSS)

The Positive and Negative Syndrome Scale (PANSS) is a 30-item instrument used to measure the syndromes of schizophrenia. Of the 30 items, seven items measure symptoms that are an exaggeration from a normal mental state (Positive scale), seven items measure features that are lacking compared to a

normal mental state (Negative Scale) and the remaining 16 items gauge the overall severity of the schizophrenic symptoms (General Psychopathology scale). There are also three supplemental items in this scale that can be used to assess aggression risk (Kay, Fiszbein, & Opler, 1987).

Other than the tests and scales mentioned above, a demographics questionnaire was used to collect information including age, education, employment status, and race. A copy of this questionnaire can be found in Appendix A.

Procedure

The participants were randomly assigned to one of the three experimental groups. All participants were assessed with the WASI within a single session one day before proceeding with the experimental conditions to which they were assigned. All groups were assessed using the WCST-64 in the sequence outlined in *Figure 2*. In the first phase of the experimental session, all the participants were assessed with the WCST-64 by the conventional procedure whereby the participants were told to sort the test cards using feedback provided by the computer (i.e. "RIGHT" or "WRONG") and without being told explicitly about the three sorting rules (colour, shape, or number). Once the participants had finished sorting all 64 test cards, the second (intervention) phase of the session began. The participants assigned to Group No Intervention were left in the room for about 15 to 20 minutes where they either read newspaper articles or checked their handphone messages. Those assigned to Group WCST Intervention were assessed another time with the WCST-64

via the conventional procedure. For those assigned to Group DA Intervention, the DA intervention (see below for a detailed description) was administered. After the intervention phase of the experiment, all participants were again administered the conventional WCST-64, after which their schizophrenia symptoms were assessed using the PANSS, and the demographic questionnaire was also administered. Thus the three experimental phases (pre-intervention assessment, intervention, post-intervention assessment) together with the PANSS and demographic questionnaire were all completed in a single session. The experiment was conducted by a graduate-level psychology student (HYY) trained in psychological test administration. The PANSS scores were also verified by the collaborating psychiatrists.

DA Intervention

The DA intervention followed a similar format to the one used by Wiedl and Wienobst (1999) and was conducted using the WCST-64. *Figure 4* is a flowchart depicting the step-by-step procedure of the DA intervention used in Study 1.

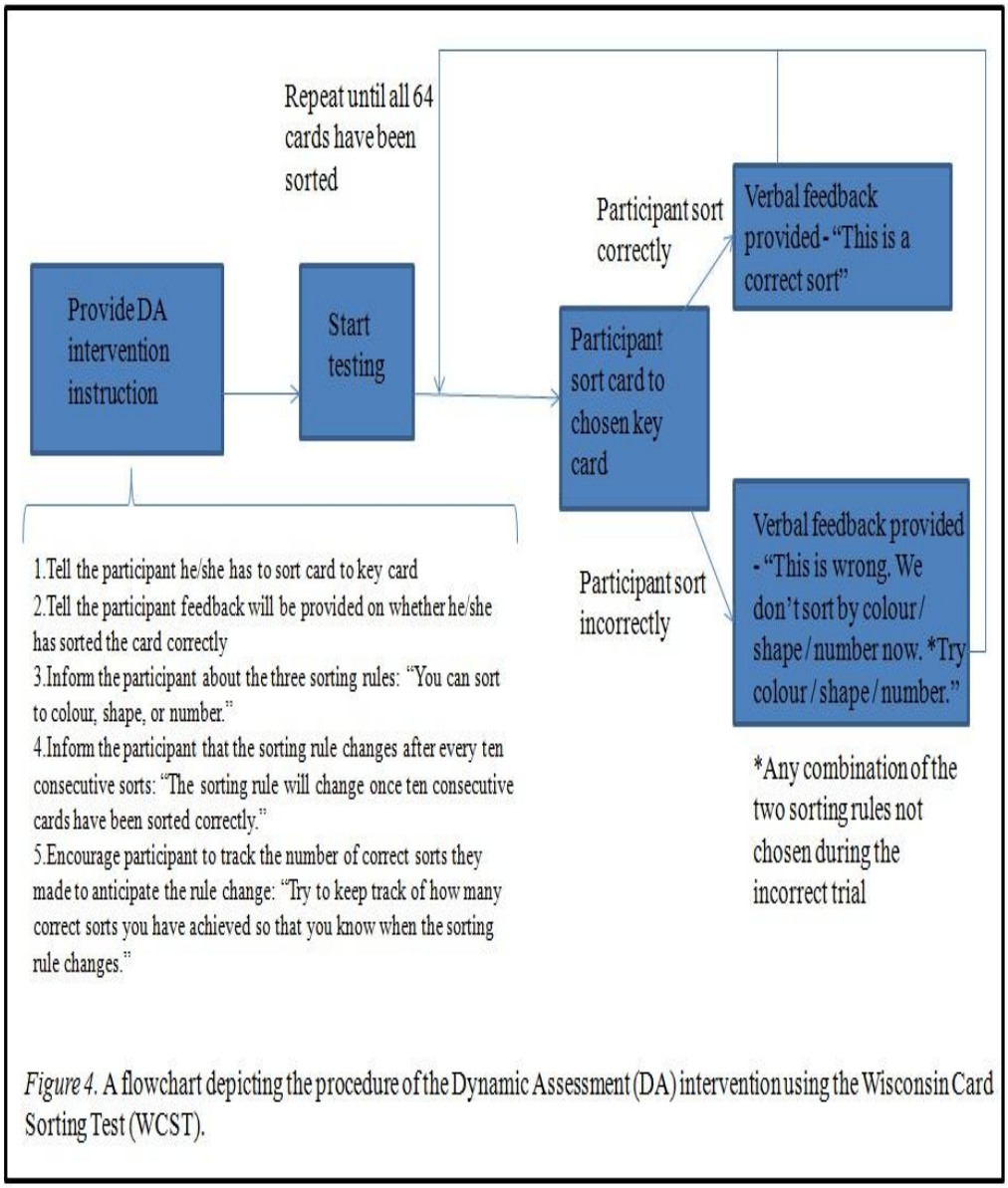


Figure 4. A flowchart depicting the procedure of the Dynamic Assessment (DA) intervention using the Wisconsin Card Sorting Test (WCST).

Coaching was provided throughout the whole intervention session. Participants were told the three sorting rules at the beginning of the intervention session. They then proceeded to start sorting whereby they were given feedback immediately after each attempt to sort a card. If they got the sort correct, they were told "This is a correct sort". If they got the sort wrong, they were corrected (e.g., "This is wrong. We don't sort by colour now. Try shape or number"). The participants were also told that the sorting rules

changed after every ten consecutive correct sorts and were encouraged to track the number of correct sorts they made to anticipate the rule change. This particular instruction was intended to help decrease participants' perseverative behaviours (often observed in schizophrenia patients) by bringing explicit awareness to their sorting behaviour so as to prevent perseveration of responses based on a particular sorting rule (e.g., repeatedly sorting on the basis of colour).

Results

As the first stage of the analysis, the Total Correct Responses (TCR), which is an overall measure of the Wisconsin Card Sorting Test (WCST) performance were compared to see if there were any effects of the different interventions across pre-intervention and post-intervention assessments. Examination of the box-plots revealed no serious threat to the assumption of normality, and there was no significant violation of homogeneity of variance (Levene's test of homogeneity of variance indicated $p > .05$, and Hartley's F_{max} was 2.42 which is less than the critical F_{max} of 3.54 for $p = .05$).

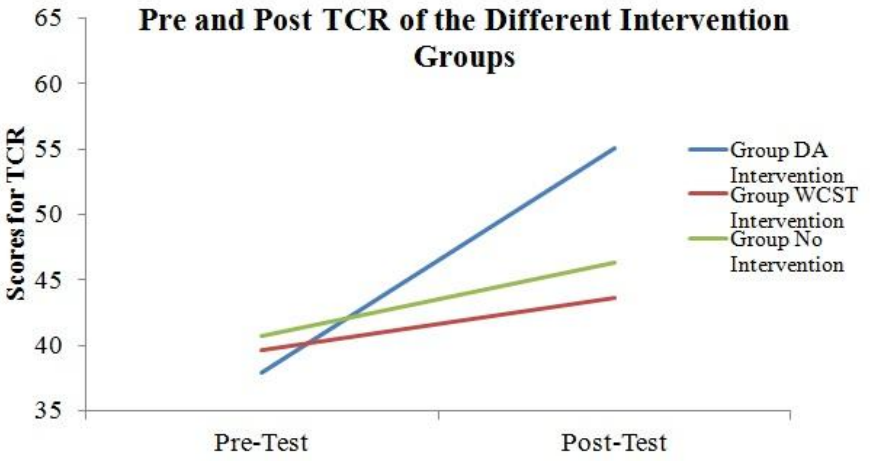


Figure 5. Pre- and Post-Test Performances on the Total Correct Responses (TCR) measure of the Wisconsin Card Sorting Test. Group DA Intervention significantly improved more from pre- to post-test time points compared to Group WCST Intervention and Group No Intervention.

Hence, a 3 x 2 mixed-design analysis of variance *(ANOVA*) was conducted on the participants' pre-intervention and post-intervention TCR scores across the three types of intervention. The level of significance was set at $p < .05$. The *ANOVA* showed a significant main effect of time ($F(1, 47) = 45.54$, $p = .00$, partial $\eta^2 = .49$) and a significant time x intervention interaction ($F(2, 47) = 10.45$, $p = .00$, partial $\eta^2 = .31$).

As seen from *Figure 5*, the TCR numerically improved in all groups of participants from pre-intervention to post-intervention assessments. This was demonstrated in the *a priori* contrasts for TCR for each intervention group (see Table 3).

Table 3.
Average Performance by Group on the Total Correct Responses (TCR) measure of the Wisconsin Card Sorting Test

	Total Correct Responses[a] (TCR)		
Group	**Pre Mean (SD)**	**Post Mean (SD)**	***F* value**
DA Intervention (n = 18)	37.89 (12.40)	55.06 (9.85)	$F(1,17) = 29.91$, $p < .0001$*
WCST Intervention (n = 14)	40.71 (11.63)	46.36 (11.94)	$F(1,13) = 9.36$, $p < .01$*
No Intervention (n = 18)	39.67 (14.57)	43.67 (15.31)	$F(1,17) = 11.39$, $p < .005$*

Note. SD = Standard Deviation; *F* value are results from the *a priori* contrasts of pre- and post-test of TCR measure within each group.
[a]The scores for TCR were raw scores.
*significant results.

The significant time x intervention interaction also suggested that at least one of the interventions resulted in more improvement than the other interventions. We expected Group DA Intervention to show greater improvement at post intervention compared to Group WCST Intervention and Group No Intervention since Group DA Intervention received coaching on the WCST and also had knowledge about the sorting rules as well as that the rule change occurred after ten correct consecutive sorts of the WCST.

Therefore subsequent 2 x 2 *ANOVA*s were then conducted on the TCR scores to test the relative efficacy of the DA intervention with respect to the other two groups, and the performance of Group WCST Intervention was compared to Group No Intervention to examine whether practice effects were found. The results indicated:

1. For Group DA Intervention versus Group WCST Intervention, there was a significant time x intervention interaction ($F(1, 30) = 8.63$, $p = .01$, partial $\eta^2 = .22$), indicating that Group DA Intervention participants improved more than those in Group WCST Intervention.

2. For Group DA Intervention versus Group No Intervention, there was a significant time x intervention interaction ($F(1, 34) = 15.40$, $p = .00$, partial $\eta^2 = .31$), indicating that Group DA Intervention participants improved more than those in Group No Intervention.

3. For Group WCST Intervention versus Group No Intervention, there was no significant time x intervention interaction ($F(1, 30) = 0.61$, $p = .44$, partial $\eta^2 = .02$) suggesting no evidence for simple practice improvements due to increased exposure to the WCST.

These results indicated that Group DA Intervention participants significantly improved more from pre-intervention assessment to post-intervention assessment time points compared to the other two groups of participants.

To further dissect the TCR measure, a second level of analysis was conducted to pinpoint which particular aspect of WCST performance was affected by the DA intervention. As mentioned in the Procedure section, part of the DA intervention instruction was intended to decrease perseverative behaviours made by the participants. Therefore, the Perseverative Errors (PE) measure was examined in this second level of analysis as it was most related to the instructions provided as part of the DA interventions to help improve WCST performance.

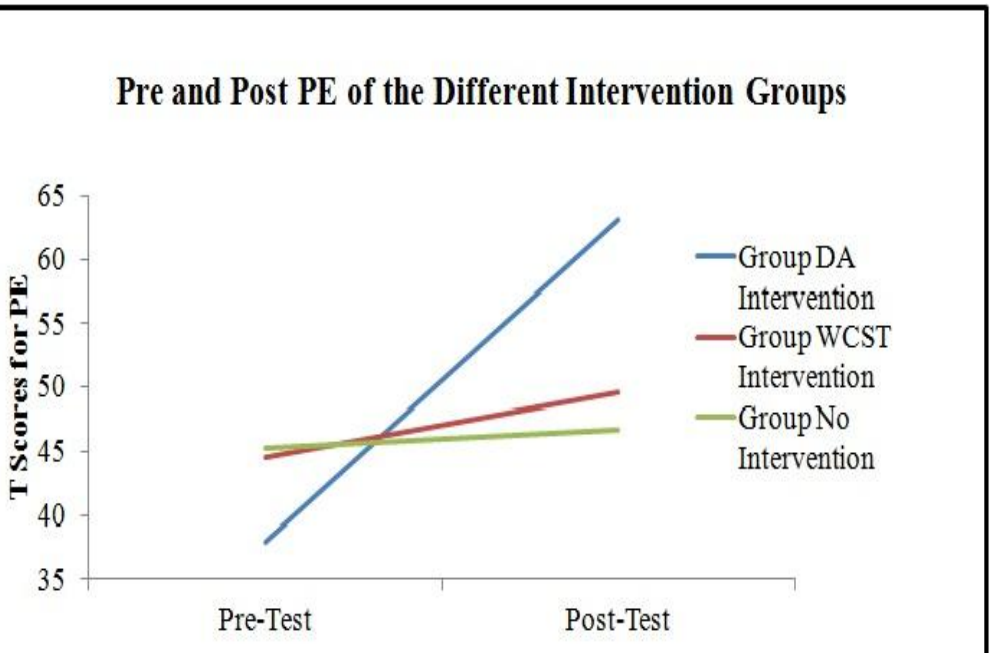


Figure 6. Pre- and Post-Test Performances on the Perseverative Errors (PE) measure of the Wisconsin Card Sorting Test. T-Scores increase as perseverative errors made decrease. Group DA Intervention significantly improved from pre- to post-test time points but not for Group WCST Intervention and Group No Intervention.

Table 4.
Average Performance by Group on the Perseverative Errors (PE) and the Nonperseverative Errors (NPE) measures of the Wisconsin Card Sorting Test

	Perseverative Errors[a,b] (PE)			**Nonperseverative Errors [a,b] (NPE)**		
Group	**Pre Mean (SD)**	**Post Mean (SD)**	***F* value**	**Pre Mean (SD)**	**Post Mean (SD)**	***F* value**
DA Intervention (n = 18)	37.89 (11.01)	63.06 (16.98)	$F(1,17) = 22.05$, $p < .005$*	40.06 (8.11)	53.28 (10.81)	$F(1,17) = 26.11$, $p < .005$*
WCST Intervention (n = 14)	44.57 (6.22)	49.64 (9.59)	$F(1,13) = 3.60$, $p > .05$	40.79 (10.53)	47.00 (11.83)	$F(1,13) = 7.29$, $p < .05$*
No Intervention (n = 18)	45.33 (10.19)	46.72 (10.65)	$F(1,17) = 0.33$, $p > .05$	40.11 (10.80)	45.44 (13.67)	$F(1,17) = 9.03$, $p < .05$*

Note. SD = Standard Deviation; *F* value are results from the *a priori* contrasts of pre- and post-test of PE and NPE measures within each group.
[a] The scores for PE and NPE had been translated into *T*-scores.
[b] As *T*-scores increase, the errors made decrease.
*significant results ($p < .05$).

As the coaching provided to Group DA Intervention taught strategies specifically intended to decrease perseverative behaviour, we expected Group DA Intervention to improve more on PE measure from pre- to post-test time points compared to Group WCST Intervention or Group No Intervention. The *a priori* contrasts revealed a significant improvement in PE scores (N.B., *T*-Scores increase as the number of perseverative errors made decreases) between pre- and post-intervention time points for Group DA Intervention but not for Group WCST Intervention and Group No Intervention (see Table 4).

Subsequent 2 x 2 *ANOVA*s were then conducted on the PE scores to test the relative efficacy of the DA intervention in decreasing perseverative errors made by Group DA Intervention participants with respect to the other two groups, and potential practice effects on the PE measure were examined by comparing Group WCST Intervention with Group No Intervention. The results indicated:

1. For Group DA Intervention versus Group WCST Intervention, there was a significant time x intervention interaction ($F(1, 30) = 9.45$, $p = .00$, partial $\eta^2 = .24$), indicating that Group DA Intervention participants committed less perseverative errors than those in Group WCST Intervention.

2. For Group DA Intervention versus Group No Intervention, there was a significant time x intervention interaction ($F(1, 34) = 16.35$, $p = .00$,

partial η^2 = .33), indicating that Group DA Intervention participants committed less perseverative errors than those in Group No Intervention.

3. For Group WCST Intervention versus Group No Intervention, there was no significant time x intervention interaction ($F(1, 30) = 1.04$, p = .32, partial η^2 = .03) suggesting no evidence for simple practice effects (due to increased exposure to the WCST) to decreasing perseverative errors committed.

Careful examination of the PE scores showed that Group DA Intervention started off numerically lower than the other two groups (see *Figure 6*). This pre-intervention assessment score difference however failed to reach significance when compared across groups. Overall, the PE results indicated that those participants in Group DA intervention improved over time on the PE measure of the WCST whereas the participants in Group WCST Intervention or Group No Intervention did not.

The NPE measure of the WCST was next analysed to continue in the effort to pinpoint which particular aspect of the WCST performance was affected by the DA intervention. Since the non-perseverative related responses of the participants were not directly targeted by the DA intervention instructions, the effect of the DA intervention on non-perseverative related responses was expected to be similar to that of simple practice effect. Therefore all three groups were expected to show improvement on the NPE measure of the

WCST from pre- to post-intervention time points. This was demonstrated in the *a priori* contrasts for NPE for each intervention group whereby results indicated significantly less non-perseverative errors (N.B., *T*-Scores increase as the number of non-perseverative errors made decreases) were committed by all three groups from pre- to post-intervention time points (see Table 4).

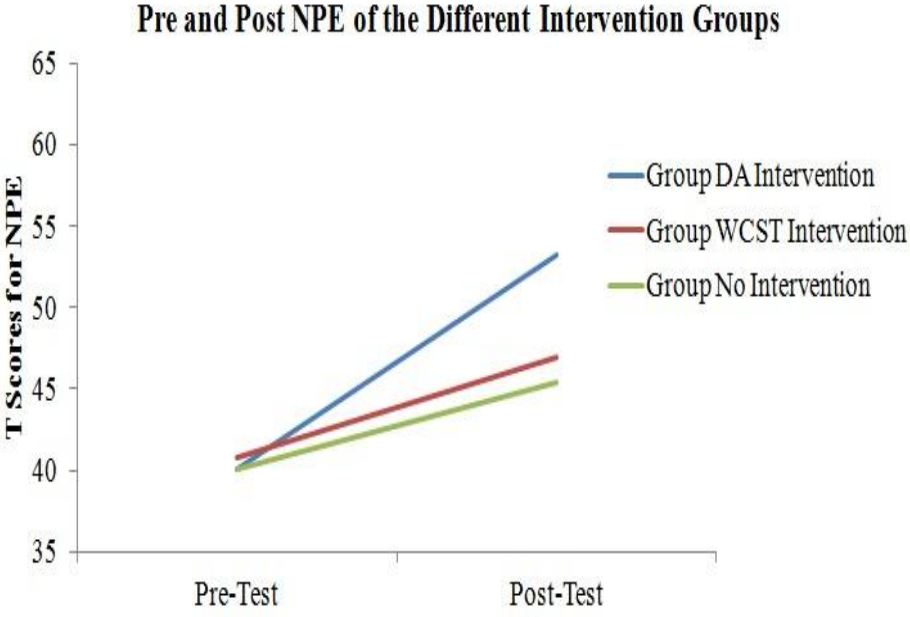


Figure 7. Pre- and Post-Test Performances on the Nonperseverative Errors (NPE) measure of the Wisconsin Card Sorting Test. T-Scores increase as nonperseverative errors made decrease. There were significant improvements from pre- to post-test time points for all three groups. Significant time x intervention interaction was found between Group DA Intervention and Group No Intervention.

Subsequent 2 x 2 *ANOVAs* were then conducted to see whether there were any differences between groups on the NPE measure from pre-intervention to post-intervention assessments. The results indicated:

1. For Group DA Intervention versus Group WCST Intervention, there was no significant time x intervention interaction ($F(1, 30) = 3.85$, $p = .06$, partial $\eta^2 = .11$), indicating that there were no difference in improvement on the non-perseverative-related errors committed by Group DA Intervention participants compared to those in Group WCST Intervention.

2. For Group DA Intervention versus Group No Intervention, there was a significant time x intervention interaction ($F(1, 34) = 6.32$, $p = .02$, partial $\eta^2 = .16$), indicating that Group DA Intervention participants committed less non-perseverative-related errors than those in Group No Intervention.

3. For Group WCST Intervention versus Group No Intervention, there was no significant time x intervention interaction ($F(1, 30) = 0.10$, $p = .76$, partial $\eta^2 = .00$) suggesting no difference in improvement on the non-perseverative-related errors committed by Group WCST Intervention participants compared to those in Group No Intervention.

In summary the results of Study 1 indicated that Group DA Intervention participants improved more compared to those in Group WCST Intervention and Group No Intervention on the overall WCST measure of TCR. Besides the TCR analyses which provided an overall picture of WCST performance changes, PE and NPE analyses were probed to test *a priori* hypotheses about the nature of the improvements seen in the DA intervention. Besides PE and

NPE, no other measures were expected to add further information and were not analyzed to avoid inflation of Type I and Type II errors. As previously discussed many of the other WCST measures are not mutually exclusive, and their inclusion in the analyses would lead to false positives due to inflation of the multiple comparisons problem (please see p.63 for more details). For the sake of completeness however, Table 5 shows the pre-intervention and post-intervention assessment scores for all the WCST measures across all three groups. To summarize, this pattern of results supports the argument that participants in Group DA Intervention showed greater improvements in WCST performance compared to participants in the other two groups because of improved PE scores (i.e., because they made fewer PE errors) and that practice effects (likely due to increased WCST exposure) may have reduced the NPE but not to a degree that was evident in the overall TCR measure.

Table 5.

Average Performance by Group on the Categories Completed, Conceptual Level Responses, Failure to Maintain Set, Trials to First Category, and Perseverative Responses Measures of the Wisconsin Card Sorting Test

	Group DA Intervention		Group WCST Intervention		Group No Intervention	
Measures	**Pre-Test**	**Post-Test**	**Pre-Test**	**Post-Test**	**Pre-Test**	**Post-Test**
Categories Completed [a]						
Mean (SD)	2.06 (1.70)	4.33 (1.50)	2.43 (1.83)	2.71 (1.98)	2.61 (1.94)	2.83 (2.18)
Min - Max	0.00 – 4.00	1.00 – 6.00	0.00 – 5.00	0.00 – 5.00	0.00 – 5.00	0.00 – 5.00
Failure to Maintain Set [a]						
Mean (SD)	0.39 (0.61)	0.72 (1.02)	0.57 (0.76)	0.86 (1.03)	0.39 (0.70)	0.61 (0.92)
Min - Max	0.00 – 2.00	0.00 – 3.00	0.00 – 2.00	0.00 – 3.00	0.00 – 2.00	0.00 – 3.00
Trials to First Category [a]						
Mean (SD)	33.17 (23.81)	12.83 (4.99)	28.43 (21.73)	25.64 (22.82)	28.44 (21.35)	23.89 (22.78)
Min - Max	11.00 – 65.00	10.00 – 31.00	10.00 – 65.00	10.00 – 65.00	11.00 – 65.00	10.00 – 65.00
Conceptual Level Responses [b]						
Mean (SD)	36.28 (10.01)	56.39 (11.86)	41.29 (9.49)	46.50 (11.20)	40.33 (11.94)	44.56 (13.66)
Min - Max	20.00 – 52.00	27.00 – 72.00	29.00 – 55.00	29.00 – 66.00	21.00 – 57.00	23.00 – 63.00
Perseverative Responses [b, c]						
Mean (SD)	38.28 (11.28)	64.44 (16.64)	45.07 (6.59)	49.71 (7.97)	45.89 (9.76)	46.67 (9.88)
Min - Max	20.00 - 52.00	23.00 - 80.00	30.00 - 53.00	39.00 - 68.00	25.00 - 73.00	21.00 - 66.00

Note. SD = Standard Deviation; Min = Minimum Score; Max = Maximum Score.

[a] The scores for Categories Completed, Failure to Maintain Set, and Trials to First Category were raw scores.

[b] The scores for Conceptual Level Responses and Perseverative Responses had been translated into *T*-scores.

[c] As *T*-scores increase, the perseverative responses made decrease.

Discussion

The purpose of Study 1 was to examine the efficacy of the DA intervention relative to the practice effects that were expected to have resulted from either: i) merely repeating the WCST assessment at the post time point (by comparing pre- and post-test performance of Group DA Intervention with Group No Intervention); or ii) by the increased exposure to the WCST that would have been experienced by Group WCST Intervention (by comparing pre-intervention and post-intervention assessment scores of Group DA Intervention with Group WCST Intervention). The participants who experienced the DA intervention showed greater improvements from pre-intervention to post-intervention assessments on the overall WCST performance measure (Total Correct Responses, TCR) compared to both Group WCST Intervention and Group No Intervention. Thus the DA intervention was shown to be more than just a practice effect attributed to either repeated WCST assessment or to prolonged WCST exposure during the intervention.

Interpreting the Results of Study 1

The second level analysis of the Perseverative Errors (PE) showed that the coaching aspect of the DA intervention was particularly effective, as evidence by the relative reduction in perseverative errors made by the participants in Group DA Intervention compared to those in the other two groups. Encouraging the participants to track their sorting behaviours therefore seemed to be effective in decreasing perseverative errors. This significant improvement in perseverative behaviours was not observed in the other two

groups who had not received this DA coaching. The specificity of the DA intervention instructions in targeting perseverative errors responses was also apparent when performances on the Nonperseverative Errors (NPE) measures were analysed. To reiterate the behaviours assessed by the NPE measure of the WCST, it collates all incorrect non-perseverative errors made by the participant during the session (e.g., losing a set by sorting to an incorrect rule before continuing with the correct sorting rule). Since the DA intervention instructions did not incorporate any instructions to correct for non-perseverative errors, the pattern of improvement on the NPE measure should not differ between the three groups. All three groups improved significantly on the NPE measure of the WCST from pre-intervention to post-intervention assessments, and Group DA Intervention did not differ from Group WCST Intervention but did differ from Group No Intervention in terms of post-intervention NPE scores. This can be interpreted as a practice effect related to increased exposure to the WCST rather than the presence of the DA intervention, given the lack of any difference in NPE scores between Group DA Intervention and Group WCST Intervention. Thus, while the improvement in perseverative errors appears to be related to the DA intervention, improvements in non-perseverative errors appear to be related to WCST-exposure practice effects.

In addition, the results generated suggested that the DA intervention produced improvements in WCST performance that were over-and-above the observed practice effects. Simple practice effect is present as can be seen from the results from the NPE measure as all three groups showed significant

improvement. The significant difference in improvement on the NPE measure found between Group DA Intervention and Group No Intervention but not between Group DA Intervention and Group WCST Intervention, or Group WCST Intervention and Group No Intervention suggested that increasing the exposure to the test also produced some improvements in WCST performance. However the practice effects were mainly confined to the NPE scores (and not the PE scores). Adding this evidence to that of the differential improvement shown in the pre- to post-intervention performances on the PE measure by the three groups, it shows that perseverative behaviours of the schizophrenia patients were targeted specifically by the DA interventions (errors that simply practising on the WCST were unable to address). Thus the results suggested that the DA intervention allowed the schizophrenia patients to reveal their latent abilities (e.g., the patients had become more attentive to avoiding their perseverative behaviours) that are not normally assessed by conventional assessment methods. It is possible to conclude therefore that the effectiveness of the DA intervention is due to more than just a practice effect, and provides justification for the efficacy of the DA paradigm.

Addressing Possible Concerns that the Nature of the DA Intervention Improves Performance by Revealing Too Much About the WCST Rules

The improvement in performance by participants in Group DA may seem less surprising if one believes that explicitly telling the participants about the identity of the three sorting rules (i.e., that they are colour, shape, and number) makes the WCST much easier to perform. Goldberg et al. (1987) as described earlier in this chapter have however shown that simply telling schizophrenia

patients about the nature of the sorting rules and the set shifting principles did not result in improved WCST performance. Another study that compared two types of DA intervention procedure found no additional advantage in explicitly telling schizophrenia patients about the identity of the WCST sorting rules (Choi and Kurtz, 2009). One DA group of schizophrenia patients underwent didactic training in which the various sorting rules and rule changing principles of the WCST were explained, and feedback was given after each sort (a training paradigm very similar to the present study's DA intervention). The other DA group underwent a self-monitoring training in which patients were asked to verbalize their sorting strategy after each trial. Although both DA groups improved at the post-intervention assessment compared to a control group who was administered an additional WCST during the intervention session, change scores in the Categories Completed measure and the Total Errors measure indicated no significant difference between the didactic training group and the self-monitoring training group.

Furthermore it is likely that the participants in the present study would have already figured out the rules and most of the test requirements by the end of pre-intervention assessment, such that revealing the identity of the rules and general test requirements would have made little difference to their post-intervention assessment scores. In this present study, it can be seen from the means of the Categories Completed scores of the pre-intervention assessments that participants from all three groups were averaging more than two categories (i.e., they knew more than two sorting rules by the end of the pre-intervention assessment, see Table 5). The pre-intervention assessment

Conceptual Level Responses scores also showed that all participants had already figured out some of the sorting rules by the end of the pre-intervention assessment – even those who did not complete a single category by the end of the pre-intervention assessment would likely have insights into the possible sorting strategies given their ability to make three or more consecutive correct sorts (Kongs et al., 2000). Observation during the pre-intervention assessments showed that many of the participants were able to identify the sorting rules as evidenced when they verbalised aloud their thoughts about how they were using the sorting rules to categorize the cards. Thus improvement in WCST performance at the post-intervention assessment in Group DA Intervention was unlikely to be due to the revealing of the identity of the three sorting rules to the participants.

Knowing the rules is only one aspect of the DA paradigm, and the ability to utilise this information and translate it into actual improved behaviour is the crux of the DA paradigm. Choi and Kurtz (2009) also showed that the improvement made by participants who had gone through the DA intervention (the didactic training group) was not advantaged by revealing of the three sorting rules because the self-monitoring group was able to show similar improvement even though they were not told the sorting rules. By asking the participants to verbalise their sorting strategy, Choi and Kurtz (2009) would be drawing their participants' attention (those in the self-monitoring group) to their sorting behaviour which could have prevented possible perseverative behaviours. This was similar to the present study's DA intervention instruction whereby the participants' attention was also drawn to their sorting behaviour

when they were encouraged to track their sorting responses in order to anticipate the rule change. It would be likely that the participants in the didactic training group would also be tracking their sorting responses since they were also made aware of the rule changing principles. This could explain why they also had similar improvement in the Total Errors measure as the participants in the self-monitoring group. Choi and Kurtz (2009) thus provided support to the argument that it was the attention to sorting responses, not the revealing of sorting rules that caused the improved post-test performance by participants who had gone through the DA intervention.

Engaging in Intentional Mediation for the Assessment of Learning Potential

The foregoing discussion highlights the essence of the DA intervention, and its advantage over conventional psychological or "static" assessment. Vygotsky and Feuerstein, whose works form the basis of the theoretical model of DA, emphasized intentional mediation (i.e., feedback and coaching) in bringing out a person's full potential. During the DA intervention of the present study when intentional mediation was performed (i.e., telling the participants about the rule and how they changed after every ten consecutive correct responses, and how participants should try to keep track of how many sorts they had correctly performed), it was observed that different participants showed different types of strategies. Some participants verbalised the number of correct sorts as a form of tracking their behaviour, while other participants used their fingers to track the number of correct sorts they had attained. While the conceptual solution to the problem was provided to the participants, the actual response to

the solution (i.e., the utilisation of strategy) differed between the participants. These instances show how DA's intentional mediation brings out a person's own potential. The participant needs to understand and to absorb the solution being offered, and then translate it into an actual improvement in performance. The DA intervention session therefore allows the participants to demonstrate any discovery of additional skills or strategies that, without this intervention, may have remained hidden (e.g., verbalising the number of correct sorts or using the fingers for tracking). The level of sophistication of the additional revealed skills or strategies is another opportunity that shows a person's Learning Potential. In the present study, to assess a participant's Learning Potential using the DA intervention, one could look at the amount of the WCST improvement between pre- and post-intervention assessments, but it is also important to observe whether a participant is able to generate novel skills and strategies as a solution to the problem. This could explain why DA proponents often claim that the intervention part of the DA assessment paradigm, the intentional mediation, is a quintessential part of the whole assessment process and provides an avenue to observe the examinee's Learning Potential. Thus besides offering an opportunity to assess a patient's Learning Potential, an advantage of the DA intervention session is that it allows clinicians to observe a patient's individualised responses to teaching and coaching. This is important as it has been suggested that variations in a patient's characteristics affect the efficacy of cognitive remediation (Wykes et al., 2011). When an individual patient's response to cognitive rehabilitation was investigated, the improvement rates of the cognitive rehabilitation program ranged from 40 to 60% (Medalia & Richardson, 2005). Therefore,

DA specifically should be considered if clinicians are considering referring the patient for rehabilitation. Clinicians could also recommend ways in which the intentional mediation during DA intervention be targeted to build upon various cognitive characteristics that may enhance the efficacy of rehabilitation with the patient.

Previous studies have shown that the intentional mediation within the DA paradigm is the likely source of the observed differential performance post-intervention. These studies have investigated whether schizophrenia patients are actively utilising the strategies taught during intentional mediation and using these strategies to reveal their Learning Potential. For example, Fiszdon et al. (2006) administered the California Verbal Learning Test (CVLT-II) to 50 schizophrenia patients. After the first administration of the CVLT, the patients were randomly assigned to two groups: one group of patients received explicit training in semantic memory strategies while the other group of patients received no training at all. After that, the CVLT was administered another two times (a different word list being used at each administration). Not surprisingly, their results indicated that explicit training about semantic memory strategies led to a greater increase in the use of the trained strategy. This result was obtained by comparing the amount of semantic clustering (a strategy taught to the patients in the explicit training group) used by patients in the pre-intervention versus post-intervention assessment sessions. The patients with explicit training used more semantic clustering during their post-intervention assessment than during their pre-intervention assessment. Thus the patients in the explicit training group were actively using the strategies

taught. Those patients who were explicitly taught the semantic memory strategies also showed greater performance increases in list recall between pre-intervention and post-intervention assessments. Thus, not only were the patients using the strategies they were taught, but it appeared these strategies were helpful in improving their performance on the task.

For the present study, active utilising of the strategies during intentional mediation was observed from the use of fingers or verbal cues to track the number of correct sorts during the post-intervention WCST assessment for those patients in the DA intervention group but not in the other two groups. This is consistent with the notion that intentional mediation plays a key role in DA-induced performance increases rather than practice effects (which the other groups would have also benefitted from). It is therefore important to look for evidence of actual utilisation of the strategies that are taught and/or self-derived during the intentional mediation (i.e., the DA intervention) to support the beneficence of the DA intervention. DA's premise of assessing Learning Potential lays in being able to observe differential level of utilisation of taught strategies.

Using Dynamic Assessment to Assess Rehabilitation Readiness of Schizophrenia Patients

Understanding how a schizophrenia patient responds to coaching is a useful way to assess their rehabilitation readiness. Teaching of new skills and strategies or imparting new information is an essential part of rehabilitation. If a patient is able to absorb the information, which is also seen in the post-

intervention performance improvement when using a DA assessment paradigm, this suggests the patient is ready for rehabilitation. DA tests the patient's responses to rehabilitation intervention by providing a sampler of rehabilitation (the DA intervention). During conventional assessment, a patient displays what he/she possesses at that moment, which does not help reveal their rehabilitation readiness (other than a need for rehabilitation if deficiencies are assessed). Conventional assessment also seldom assesses a patient's ability to learn which is what will be expected after enrolment in a rehabilitation program. Therefore DA may be more suitable in assessing rehabilitation readiness than conventional assessment.

For DA to become an assessment tool of rehabilitation potential in schizophrenia patients, it is also important that its assessment paradigm accurately targets the cognitive domain most related to their functional outcomes, which is also the area most rehabilitation interventions are trying to improve. Perseveration, a measure of cognitive flexibility (an element of executive function), characterizes a type of behaviour whereby the behaviour unintentionally keeps repeating itself despite the presence of feedback that indicates that the behaviour is incorrect (Waford & Lewine, 2010). Most importantly, perseveration is also a symptom consistently present in schizophrenia patients and is related to poorer community, social, and occupational functions (Waford & Lewine, 2010; Green, 1996; Lysaker, Bryson, Davis, & Bell, 2005). Thus it is not surprising that a large part of the DA instructions focus on decreasing perseverative behaviours. Since DA is advocating itself as a tool where its assessment results have implication for

functional outcomes of schizophrenia patients, the assessment paradigm must be in some way directed at perseverative behaviours. The DA intervention instructions in the present study focused on decreasing perseverative behaviours of the participants by telling the participants to track the number of correct sorts as a way to draw their attention to any perseverative responses. Therefore, it is reassuring that the present study found that the DA intervention successfully reduced perseverative errors committed by the participants (as observed in the improved pre-intervention to post-intervention performance on the Perseverative Error measure compared to other participants who did not have DA intervention). Thus DA of perseverative behaviour via the WCST is strategic in the assessment of rehabilitation potential and this adds further support for DA as a tool to assess rehabilitation potential of schizophrenia patients.

Possible Motivation Effects on the Group WCST Intervention Results

The issue of motivation of schizophrenia patients is an area of recent interest – specifically the relationship between motivation, cognition, and functional outcomes (Nakagami, Hoe, & Brekke, 2010; Nakagami, Xie, Hoe, & Brekke, 2008; Gard, Fisher, Garrett, Genevsky, & Vinogradov, 2009). For example, Nakagami et al. (2008) examined the association of these factors in 120 schizophrenia patients by administering cognitive tests (i.e., the Controlled Oral Word Association Test, Digit Span Distractibility Test, California Verbal Learning Test, Degraded-Stimulus Continuous Performance Test, and WCST). The patients' motivation level was also measured via the intrapsychic deficit subscale of the Quality of Life Scale, and psychosocial functioning level of the

patients was established using the Role Functioning Scale from the Community Adjustment Form. Significant positive correlations ($p < .01$) were found between cognition and psychosocial functioning ($r = 0.26$), cognition and motivation ($r = 0.57$), and motivation and psychosocial functioning ($r = 0.65$). Subsequent analysis using structural equation modelling found that the motivation level of patients mediated the relationship between cognition and psychosocial functioning. Thus efficacy of rehabilitation can be affected by schizophrenia patients' motivation level, whether it is an inherent characteristic of the patient or part of the negative symptoms (i.e., being amotivated or being avolitional). The issue of motivation then becomes an important factor to consider in the treatment of a schizophrenia patient.

For the present study, the motivation level of the schizophrenia participants could also be a potential factor that affected the results, and it has been suggested in the literature that poor motivation may result in poor performance on cognitive tasks (Nakagami et al., 2010; Sharma, & Antonova, 2003). Given that the design of the present study required participants to repeat the WCST several times, a decrease in motivation to complete the test that differed across groups could have affected the performance measures. It was with this potential issue of decreasing motivation in mind that the 64-card version of the WCST was chosen for the present study rather than the full 128-card WCST version. When participants in Group WCST Intervention repeated the WCST three times, it is possible that these participants may have been the least motivated during the post-intervention WCST assessment. For this to explain the pattern of results in Study 1, one would have to argue that slight WCST

post-intervention performance gains in Group WCST Intervention would have been affected by the decrease in their motivation level such that the their performance was only slightly higher than the post-intervention WCST performance of Group No Intervention. Running contrary to this argument is research finding that points towards a mutually reinforcing model of motivation and mastery of skills whereby improvement instead increases motivation to perform which in turn results in improvement over time (e.g., Nakagami et al., 2010).

The result from this present study showed improvement in the WCST performance from pre- to post-intervention assessments for all groups. It is also reasonable to argue therefore following the rationale of the reinforcing nature of motivation and mastery, that motivation to perform well on the WCST would have increased among the participants with the increasing sense of mastery of the test. While both arguments are plausible, it seemed from the responses during the debrief interview conducted during the pilot study of this experiment that none of the schizophrenia participants felt either tired or bored by the WCST or the intervention phase. Some expressed even more motivation to solve the test and the puzzle of fluctuating feedback. Therefore, lack of motivation and boredom may not have been an issue in this present study. However this would be an important factor to explore in future studies, which could formally assess motivation level throughout the experiment.

Limitations

Even though this study generally provided support for the DA paradigm, there were some limitations. One issue would be the medication dosage. Even though there was no significant difference in the medication dosage level between groups, the large standard deviation might be of concern, and future studies may want to have better control over this variable. Nevertheless, medication dosage remained consistent for each participant throughout the short duration of the present study, and because within-participant statistics were used, this may not be too much of an issue. In fact, the variable dosage from one participant to another may enhance generalization to other patients in the population.

Another limitation was the ceiling-effect for the DA version of the WCST. *Figure 8* shows the WCST pre-intervention and post-intervention assessment scores of individual participants in Group DA Intervention. Most participants achieved the upper limit of the test after receiving DA intervention. This suggests that the WCST is perhaps not difficult enough to differentiate between participants who show improvements following the DA intervention. This ceiling effect resulted in an inability to test the upper limits of Learning Potential for some participants who may have been underestimated in terms of their true abilities. For such high performing patients, clinicians may want to consider using a more difficult version of this test (or perhaps a newly devised test specifically for this purpose) to test the upper limits of these patients' Learning Potential. Future work could be aimed at developing such DA tests.

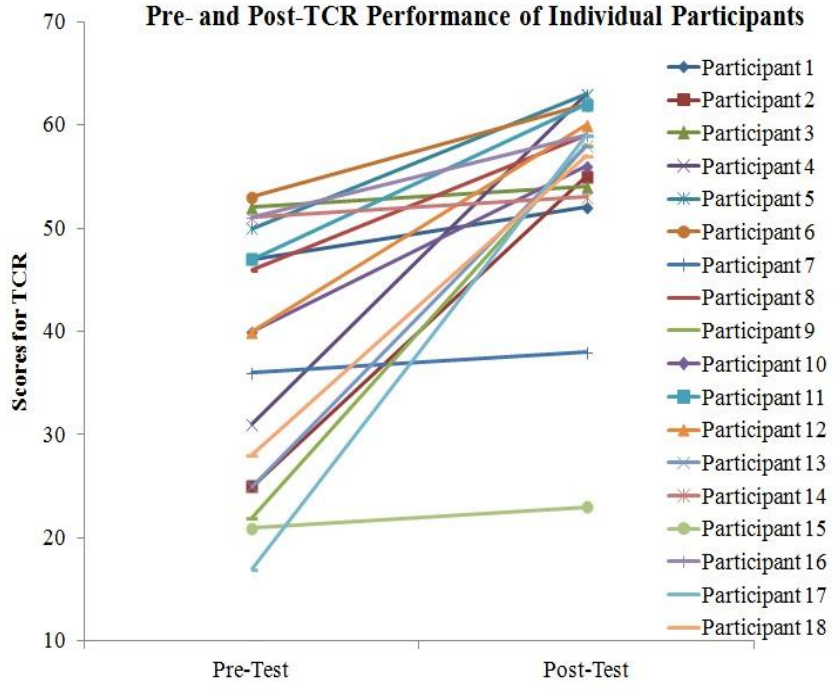


Figure 8. Pre- and Post-Test Performance on the Total Correct Responses (TCR) measure by Individual Participants in Group DA Intervention.

Conclusions from Study 1

The results of Study 1 indicated that schizophrenia patients do benefit from the DA intervention especially in terms of their perseverative behaviours. This is the first step in establishing the efficacy of the DA paradigm. Another step forward in this endeavour is to examine the construct that DA is proposed to measure. As discussed in Chapter 3, Learning Potential has various definitions. From the psychometric perspective, this is a weakness for the field of DA. A fundamental criterion of establishing a psychological test is that it must clearly measure a particular construct (and not other constructs) and be supported by evidence of its validity and reliability (e.g., Kamphaus, Winsor, Rowe, & Kim (2005)). Study 2 further explores the Learning Potential

construct by studying the relationship between Learning Potential and other factors such as intelligence (IQ), age, medication and symptomatology.

Chapter 5: Study 2

Rising healthcare cost is an issue faced by many countries in the world, especially for the mental healthcare sector. The World Health Organisation estimated that the majority of its member countries only contributed less than 1% of their total healthcare expenditures to mental healthcare budget (World Health Organisation, 2001). This could mean that not enough healthcare resources will be channelled into mental healthcare programs, including those that can help schizophrenia patients. With limited healthcare resources to conduct effective treatment and rehabilitation programs, clinicians will face pressure to minimise wastage of such resources. For clinicians who treat schizophrenia patients, one way to minimise wastage is to find a better fit between a patient's clinical profile and rehabilitation interventions (Silverstein & Wilkniss, 2004). DA is one possible solution that can meet this challenge by assessing schizophrenia patients' rehabilitation potential. Using this information, DA proponents suggest that clinicians can then find a suitable rehabilitation program that fits the patient's potential. In this way, potential wastage from ineffective interventions and poor treatment outcome can be minimised.

In Singapore's context, DA can potentially allow Singapore to extract a greater value from the healthcare budget. The Ministry of Health formed a task force to formulate a National Mental Health Policy and Blueprint in 2005. An area of focus was the access to and evaluation of healthcare services (Chong, 2007). In a press release by the Ministry on 30 September 2007, it was announced that part of the S$40 million budget would be invested to

increase rehabilitation programs for mental health patients (Ministry of Health Singapore, 2007). With a mandate from policymakers to improve rehabilitation services, clinicians working on the ground should also ensure that appropriate healthcare services are delivered to the appropriate patients.

With rehabilitation (specifically cognitive rehabilitation) programs for mental health patients in an early stage of development in Singapore, it will be timely and important to identify assessment tools that can assist clinicians in identifying the appropriate patients who would benefit from such rehabilitation programs. With an objective measurement to supplement clinical judgement, patients could also benefit more from a referral process that is able to pinpoint their abilities and needs more accurately. This would also be a very practical way to meet the Ministry's objective of improving healthcare services for mental health patients.

Another way of assessing a patient's likely benefit from a rehabilitation program is by way of assessing their intelligence. The interest in intelligence testing has a long history that traces back to Alfred Binet, who in 1905 introduced what is now known as the Stanford-Binet Intelligence Scale and the Intelligence Quotient (IQ) at the request of the French Ministry of Public Instruction to develop a reliable diagnostic system to identify children with mental retardation. This interest in measuring intelligence further intensified during World War I, when IQ testing was carried out for all army recruits in America, and since then intelligence testing has become an integral part of psychological assessment (Wasserman & Tulsky, 2005).

Research has established that Intelligence Quotient (IQ), an estimate of general intelligence, predicts neuropsychological performance in normal adults (Diaz-Asper, Schretlen, & Pearlson, 2004). In a clinical setting, it is common therefore for clinicians to assess a person's intelligence and to use that to estimate the person's performance on other neuropsychological tests. However, the relationship may not be as clear cut when the population being estimated is one with a disorder that often manifests with cognitive deficits such as schizophrenia. Besides specific cognitive deficits, it has been argued that schizophrenia patients also suffer general intellectual decline (McKenna, 1994; Haywood & Lidz, 2007). As with the research on the trajectory of cognitive deficits in schizophrenia patients, researchers are also interested to find out when IQ starts to decline in these patients. This research has shown mixed results with some suggesting that schizophrenia patients already had lower IQ at childhood before the onset of illness (Russell, Munro, Jones, Hemsley, & Murray, 1997; Goldberg et al., 1995). However, others had also suggested that IQ might not necessary decline in schizophrenia patients (e.g., Weickert et al., 2000). In the midst of this debate lays an important practical issue: whether there are distinct cognitive profiles for different levels of IQ within the schizophrenia population. This would be an important issue for clinicians to understand – especially when estimating cognitive performance in impaired patients.

Kremen, Seidman, Faraone, and Tsuang (2001) administered the Wechsler Adult Intelligence Scale-Revised (WASI-R) to 36 schizophrenia patients, and grouped them as either "High IQ" or "Low IQ" based on their full-scale IQ

estimate. They found the pattern of cognitive strengths and weaknesses to be quite similar between the two groups, except that abstractive-executive functions were more impaired in the "Low IQ" group. Weickert et al. (2000) also found different cognitive profiles between schizophrenia patients with compromised intellect (in whom premorbid IQ was below 90), deteriorated intellect (in whom there was a decline of at least 10 IQ points from premorbid levels), and preserved intellect (in whom there was a premorbid IQ of at least 90 points and a less than 10 points decline in current IQ compared to premorbid IQ). They found that the patients with compromised intellect had deficits in executive function, memory, and attention, while the deteriorated intellect patients had all the above deficits in addition to language and visual processing deficits. The preserved intellect patients exhibited similar cognitive profiles to normal controls except for poorer performance on tests of executive function and attention. Thus, it seems that different levels of intelligence functioning in schizophrenia patients are associated with different cognitive profiles.

As well as intellectual functioning affecting cognitive profiles, it is also possible that a schizophrenia patient's intellectual level may be an agent behind his/her Learning Potential. For example, Wiedl and Wienobst (1999) suggested that schizophrenia patients' performance on the DA version of WCST would indicate their Learning Potential and hence their rehabilitation potential. Based on their performance on the dynamically administered WCST, the patients were classified as "High Scorers", "Learners", or "Non Learners". High Scorers were defined as those who had scored 44 and above

on the Total Correct Responses (TCR) measure of the WCST (upper level – 1.5 SD) in pre-intervention and post-intervention assessments. Learners were those patients who had improved their performance from pre-intervention to post-intervention assessments by more than 15 points on the TCR (1.5 SD). Those who did not meet both of these two criteria were classified as Non Learners (see *Figure 9*). All the patients also underwent a rehabilitation program aimed to ameliorate both cognitive dysfunctions and social behavioural deficits in schizophrenia. Based on their performance following the rehabilitation program, these patients were then classified into those with low training proficiency (i.e., little improvement resulting from the rehabilitation program) or those with high training proficiency (i.e., much improvement resulting from the rehabilitation program). High Scorers consistently fell into the high training proficiency category whereas the Non Learners consistently fell into the low training proficiency category. Learners could be found in both the high and low training proficiency categories. Wiedl and Wienobst (1999) then went on to show that when education level was taken into account as a moderating factor, Learners with higher education background typically were classified as high training proficiency whereas the Learners with lower education background were typically classified as low training proficiency.

It is quite possible therefore that High Scorers belong to the group of schizophrenia patients whose intellect is not compromised but preserved (see also Weickert et al., 2000). Thus, preserved intellect may explain their better performance on the WCST, and Wiedl and Wienobst (1999) concluded that

education level was a moderating factor in deciphering low or high training proficiency among Learners. This is consistent with the idea that intellectual functioning might be predictive of their Learning Potential, and would be useful to know since IQ testing might be a more efficient method of assessing Learning Potential, and hence predicting rehabilitation potential. Thus, an alternative explanation for the high Learning Potential of High Scorers and Learners in Wiedl & Wienobst (1999)'s study is that schizophrenia patients' Learning Potential could be predicted (more simply and quickly than via DA) by assessing their intellectual statuses in order to determine their Learning Potential.

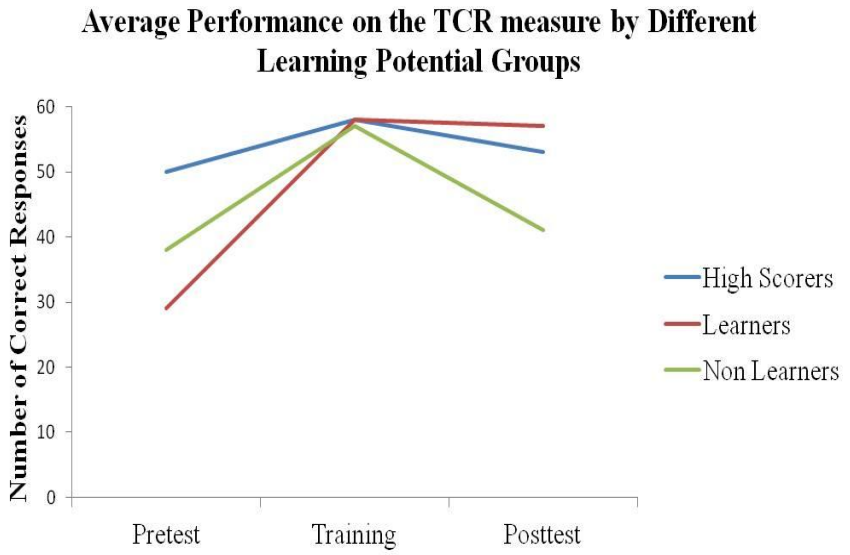


Figure 9. Performance on the Total Correct Responses (TCR) measure of the Wisconsin Card Sorting Test (WCST) by Different Learning Potential Groups. The three learning potential groups are High Scorers, Learners, and Non Learners. Grouping is done according to the pre- and post-test performance on the TCR measure of WCST. High Scorers are defined as those who have scored between the upper level of 58 and lower level of 43 (upper level – 1.5 SD) in pre- and post-test. Learners are those who have improved their performance from pre- to post-test by at least 15 points (1.5 SD). Those who do not meet either of the two criterions are classified as Non Learners. The graph is adapted from Wiedl and Wienobst (1999).

Unfortunately, Wiedl and Wienobst (1999) did not report the IQ data for their participants (only their level of education). Some researchers have explored assumptions about the relationship between education level and intelligence because of the positive correlation often found between these two factors. For example, Lynn, Meisenberg, Mikk, and Williams (2007) found a compelling association of more than 80% ($r > 0.90$) between IQ scores and education levels across more than 60 countries, and thus education has oftentimes used as a proxy for intellectual/cognitive abilities in group studies (Barber, 2005; Rindermann & Meisenberg, 2009). In addition, Fiszdon, Choi, Bryson, and Bell (2006) studied schizophrenia patients with preserved intelligence (patients whose intellectual function did not change from premorbid levels), compromised intelligence (patients with consistently low intellectual function), and deteriorated intelligence (patients whose intellectual function declined after the onset of the disorder) to determine their responses to rehabilitation programs. Those patients with preserved and deteriorated intelligence benefited the most from cognitive rehabilitation compared to those with compromised intelligence (i.e., those with higher IQ were generally more responsive to the rehabilitation program). Based on the findings of Fiszdon et al. (2006), it might therefore be argued that conventional IQ testing could replace DA as a means of assessing which patients are most likely to benefit most from the rehabilitation programs. Clinicians may also see the advantage of using the conventional IQ testing paradigm since it is already a part of the standard assessment battery, and will not therefore require so much of additional clinical resources or justification for each patient.

From the perspective of DA proponents, it would be important to clarify the relationship between Learning Potential (a key construct within DA) and intelligence. This would enable the field to refine their definition of Learning Potential, and to investigate whether intelligence or Learning Potential is a better predictor of rehabilitation potential or functional outcome in schizophrenia patients.

As described earlier, Wiedl and Wienobst (1999)'s study suggested that Learning Potential indicated rehabilitation potential. This idea was extended by Watzke, Brieger, Kuss, Schoettke, and Wiedl (2008) by showing that Learning Potential status also predicted work capability after the completion of the rehabilitation program. Using the DA version of WCST and the same Learning Potential status categorisation as described by Wiedl and Wienobst (1999), they grouped 41 schizophrenia and schizoaffective patients as either High Scorers, Learners, or Non Learners, and followed them through a nine-month vocational rehabilitation program. Assessment of the patients' work capability was performed at the intake to the vocational rehabilitation program, repeated 26 weeks into the program, again at the completion of the program, and finally at three months after the completion of the program. High Scorers consistently fared well on the work capability assessment at all time points while Non Learners consistently fared more poorly on the assessment at all time points compared to the High Scorers. The Learners started the rehabilitation program with performance consistent with the Non Learners, however the differentiation of performance between Learners and Non Learners became more significant as the program progressed. Assessment

conducted three months after the completion of the program showed no significant difference between the High Scorers and Learners, but a significant difference between Learners and Non Learners. Thus, High Scorers consistently coped well with the program demands while Non Learners consistently performed worse, which was predicted by their Learning Potential statuses. The Learners' performance contributed most to the Learning Potential prediction, which suggested that even though their initial performance was poor, with good Learning Potential and a conducive environment, their performance could be improved. In terms of brain function, a proton magnetic resonance spectroscopy study investigated brain metabolites of schizophrenia patients and healthy controls who were dynamically assessed with the WCST (Ohrmann et al., 2008). It was found that N-acetylaspartate (NAA, a marker of neuronal integrity) was positively correlated with Learning Potential for both healthy controls and schizophrenia patients. The authors suggested an association between the viability of neurons and Learning Potential. This is consistent with the notion within DA that Learning Potential status can predict rehabilitation and functional outcome.

Thus, assessing Learning Potential provides a way of estimating how ready a patient is for learning the skills and strategies that the rehabilitation program has to offer. Through a pre-test – intervention – post-test assessment scenario, the performance improvement arising from the intervention reveals valuable insights about rehabilitation potential of the patient. In this way, clinicians could assess whether the patient is likely to benefit from a rehabilitation program. Watzke et al. (2008)'s results suggested that Non Learners might not

be as ready for (or may require a more step-down version of) the rehabilitation program as compared to the High Scorers and Learners. This should prove very helpful to clinicians, who could therefore use DA to help them decide who among their schizophrenia patients have the Learning Potential characteristics that indicate their likelihood of benefitting most from the rehabilitation programs.

The ability to predict rehabilitation outcome therefore has considerable value in the clinical setting. Understanding the role of intellectual function and having a well-defined Learning Potential construct is one step towards achieving this goal. To help with this goal, the aim of Study 2 was to investigate the relationship between intellectual function (as estimated by IQ score) and Learning Potential (as a step towards properly defining the Learning Potential construct). Based on the above discussion about intellectual function as a possible element in Learning Potential, a relationship between intellectual function and Learning Potential was suggested: that Learning Potential seen from the amount of improvement from pre-intervention to post-intervention assessments increases with higher intellectual function. Improvement would be calculated from a standard formula for gain scores by dividing actual gain (Post-intervention assessment score – pre-intervention assessment score) by potential gain (perfect performance score – pre-intervention assessment score) (Sergi et al., 2005). Such a calculation of gain score is to view Learning Potential from a dimensional perspective (i.e., the higher the gain score, higher the Learning Potential) rather than a categorical

approach as used in Wiedl and Wienobst (1999). The following hypothesis was proposed to test this assumption:

1. The IQ score is a predictor of the gain scores calculated from pre- to post-intervention assessment scores on the Total Correct Responses (TCR) measure of WCST performance.

To be comprehensive, the relationships between age, medication, and negative symptoms of schizophrenia with Learning Potential were also examined separately. Possible associations are that: Learning Potential as seen from the amount of improvement from pre- to post-intervention assessments decreases with increasing age, medication, and negative symptoms. The hypotheses were thus:

2. The age of a schizophrenia patient is a predictor of the gain scores calculated from pre- to post-intervention assessment scores on the TCR measure of WCST performance.

3. The medication dosage (converted to CPZ equivalence) a schizophrenia patient is on is a predictor of the gain scores calculated from pre- to post-intervention assessment scores on the TCR measure of WCST performance.

4. The negative symptoms of a schizophrenia patient is a predictor of the gain scores calculated from pre- to post-intervention assessment scores on the TCR measure of WCST performance.

Finally, the necessity of using DA to predict Learning Potential was also examined. This was done by examining whether performances (of the patients in Group No Intervention of Study 1) on the pre-test TCR measure of the WCST could be a predictor of gain scores. If so, then better gain scores will be seen together with better pre- intervention TCR performance. The hypothesis was:

5. The performance on the pre-test TCR measure of the WCST is a predictor of the gain scores calculated from pre- to post-intervention assessment scores on the TCR measure of WCST performance.

The Design of Study 2

The design of this study was incorporated into the design of Study 1, specifically the Group DA Intervention portion of Study 1. To examine the relationship between intellectual functions (and other factors such as age, medication, and negative symptoms) and Learning Potential of schizophrenia patients, the IQ information (and the relevant demographic and clinical information) of the schizophrenia patients recruited and randomized into Group DA Intervention of Study 1 were assessed along with their Learning Potential information (the gain scores calculated from pre- to post-intervention assessment scores on the TCR measure of WCST performance).

To reiterate the design of the Group DA Intervention portion of Study 1, the schizophrenia patients recruited were assessed with the Wechsler Abbreviated Scale of Intelligence (WASI) to estimate their level of intellectual function. The patients were also administered the WCST dynamically. Demographic and clinical information were also collected. *Figure 10* is a schematic representation of the design of Study 2.

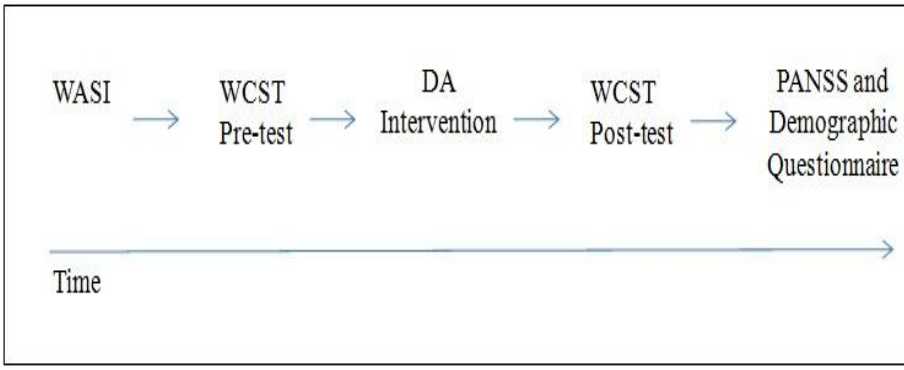


Figure 10. Design of Study 2. WASI denotes Wechsler Abbreviated Scale of Intelligence; WCST denotes Wisconsin Card Sorting Test; DA denotes dynamic assessment; PANSS denotes Positive and Negative Syndrome Scale.

Participants

Participants for Study 2 were the eighteen patients diagnosed with schizophrenia or schizoaffective disorders recruited and randomized into Group DA Intervention of Study 1. The demographic and clinical characteristics of the participants are in Table 2 labelled under Group DA Intervention.

Materials

Two neuropsychological tests were used in this study: the Wechsler Abbreviated Scale of Intelligence (WASI) for the measurement of intellectual function of the patients, and the computerized WCST-64 version of the Wisconsin Card Sorting Test (WCST) for the assessment of Learning Potential. The Positive and Negative Syndrome Scale (PANSS) and a demographic questionnaire were also used.

Procedure

Since the participants in Study 2 were a subset of participants recruited for Study 1, specifically those assigned to Group DA Intervention, the procedure of Study 2 was the same as those for Group DA Intervention of Study 1. To reiterate the procedure, the participants were first assessed with the WASI a day before the DA session. All WASI assessments were completed within one session. During the DA session carried out the next day, the participants were first administered the WCST in the conventional way. After that, the intervention phase began whereby the participants were given training on the WCST. The exact instructions for the intervention phase can be found in Chapter 4. Briefly, the intervention entailed informing the participants about the sorting rule and the change in sorting rules. Feedback for each trial was also provided. All 64 test cards were used in the intervention phase. After the intervention was completed, the participants were administered the WCST in the conventional way once again. This was followed by the administration of the PANSS and the demographic questionnaire. All the sessions were conducted in an individual assessment setting.

Results

To examine the relationship between the IQ score (WASI Full Scale IQ score) and the Learning Potential assessed by DA, the schizophrenia participants' gain scores were first calculated using scores obtained from the TCR measure of the WCST and the formula provided by Sergi et al. (2005), which is the actual gain (post-intervention assessment score on TCR – pre-intervention assessment score on TCR) divided by potential gain (perfect performance score on TCR – pre-intervention assessment score on TCR). Simple regression was then used to see if the gain score could be predicted by the IQ score. However, the regression model was not significant (R^2 = .10, p = .21). This indicated that WASI IQ score was not a good predictor of the gain scores.

Even though IQ score was not a significant predictor, it was possible that other variables like negative symptoms and the participant's amount of antipsychotic medication could influence the gain score. Thus, a multiple regression was also performed with the PANSS Negative Scale score, and medication dosage (converted to CPZ equivalence) as predictors to see if any of these factors were predictors of gain score. Age was also added into the analysis, using this opportunity to clarify the different conclusions reached by McGurk et al. (2007) and Wykes et al. (2011) about the effect of age of schizophrenia patients on efficacy of cognitive rehabilitation programs. The forced entry method of regression was chosen since the predictors were chosen based on past research findings. Once again, the model was not significant (R^2 = .10, p = .78), and the PANSS Negative Scale score (β = -.11, p = .74), medication dosage (β = .29, p = .39), and age (β = .22, p = .49) were

not good predictors of the gain score. Thus the information about age and clinical information (i.e., medication dosage, severity of negative symptoms, intellectual function) that is usually collected about the schizophrenia patients by healthcare professionals in a conventional clinical setting were not good predictors of gain scores in this current sample of schizophrenia patients who underwent the DA intervention.

However the regression analyses reported above are not enough to rule out the possibility of a complex interactive relationship between IQ score and change in gain score. There is a possibility that IQ could have affected the ability of patients to benefit from the DA intervention. For example, if high IQ patients were to have benefitted less from the DA intervention compared to lower IQ patients, then the relationship between IQ and gain scores could be masked by these interaction effects. To attempt to tease out a possible interaction between IQ and DA intervention, the control group's (Group No Intervention; N = 18) IQ scores were also investigated. The rationale was that because the participants in Group No Intervention had not received DA (see details of the procedure in Chapter 4's Procedure section), any effects of IQ could be studied without any possible mediating influences from the DA intervention. Simple regression was conducted using IQ score as predictor of gain score. Once again, the regression model was not significant (R^2 = .09, p = .22). A similar multiple regression conducted for Group DA Intervention was also conducted for Group No Intervention to investigate possible predictors other than IQ score. The multiple regression result also showed a non significant model (R^2 = .11, p = .67) with the PANSS Negative Scale score (β = .27, p =

.33), medication dosage (β = .-.21, p = .45), and age (β = -.06, p = .24) being non-significant predictors of gain scores.

The efficacy of DA was further investigated by examining if it was necessary to conduct DA intervention to access Learning Potential. This was done by examining whether performance on the pre-test TCR measure of the WCST could be a predictor of gain scores for the Group No Intervention. The rationale was that if pre-intervention assessment TCR scores could predict gain scores without any DA intervention, then any advantage of using DA would be questionable. The simple regression conducted showed pre-intervention assessment TCR scores were was not a good predictor of gain scores (R^2 = .05, p = .35).

Discussion

The aim of Study 2 was to ascertain the possible relationship between intellectual function and Learning Potential. To examine this relationship, simple regression analysis was conducted to see whether the IQ score could predict the gain score calculated from the change in pre- and post-intervention assessment TCR scores among the participants in Group DA Intervention. The analysis however showed no significant association between IQ and gain scores. The possibility of the effect of intellectual function being masked by an interaction with the DA intervention was further studied by analysing the IQ score and gain scores of the control group (Group No Intervention) which did not receive the DA intervention. The regression model was also not significant and hence no evidence for an association between IQ and gain

scores was found. Thus the Learning Potential construct which is estimated from the gain scores seemed to be independent of intellectual function (at least as assessed by IQ).

Interpreting the Results of Study 2

With this result, it means that the patients with better Learning Potential, and according to Wiedl and Wienobst (1999) those most likely to benefit from rehabilitation, are not necessarily those with better IQ scores. Therefore, if clinicians are to simply rely on using schizophrenia patients' IQ as a gauge for rehabilitation potential, they may miss out on patients who could greatly benefit from the rehabilitation program. Bell, Bryson, and Wexler (2003) studied severely impaired schizophrenia patients (cognitive tests performances of 1 SD below mean) and they found that working memory of these patients improved with cognitive rehabilitation. These were patients who would usually be deemed poor candidates for interventions yet they were able to benefit from the rehabilitation. For such patients, the present Study 2 suggests that an assessment of their Learning Potential might have enabled clinicians to detect their rehabilitation potential and not miss the chance to help them. Relying on IQ scores to select patients for rehabilitation may also select patients with higher IQ who will not necessarily benefit very much from the rehabilitation programs, resulting in sub-optimal allocation of healthcare resources.

In fact other research has also shown that it may be counterproductive to use a patient's IQ score as a predictor of successful rehabilitation outcome. First of

all, patients with preserved intellect are not the same as healthy controls. Badcock, Dragovic, Waters, and Jablensky (2005) argued that schizophrenia patients with preserved IQ had pockets of cognitive dysfunction that could impact on their ability to benefit from rehabilitation. They found slower cognitive processing times among patients with preserved IQ compared to healthy controls. Kremen et al. (2001) also found widespread compromised cognitive functions among schizophrenia patients with preserved IQ compared to IQ-matched controls. Hence the usual estimation of cognitive abilities from IQ result may not work as well for the schizophrenia population. Thus taking a patient's IQ at face value, even for those with preserved IQ, runs the risk of ignoring subtle cognitive deficits that can affect how these patients will respond to rehabilitation.

Moreover, the interacting effects of schizophrenia, education opportunities and IQ scores could be problematic for the use of IQ score as a prediction of rehabilitation potential. It was discussed earlier about the close association between education and IQ scores (r >.90). Lynn et al. (2007) also suggested the association between years of education and IQ by showing that the length of schooling closely determined the performance on IQ tests, with each additional year of education raising the IQ scores of children by 0.25 to 6 points. Schizophrenia patients tend to have lower cognitive functioning compared to healthy siblings and peers even at childhood. Pre-schizophrenic children also tend to have abnormal social behaviours which can lead to social adjustment problems (Walker, Kestler, Bollini, & Hochman, 2004). These early childhood issues could therefore have led to poor IQ scores because of

missed opportunities in school. Fuller et al. (2002) showed that standardized achievement test scores of children who later developed schizophrenia were significantly lower between the ages of 13 – 16 years. It was suggested that early detrimental effects on educational exposure could have affected the IQ gains that schizophrenia patients could have achieved otherwise. Thus, schizophrenia patients' IQ could be under-estimated because of lost educational opportunities suffered in childhood. It could be argued therefore that if a schizophrenia patient's rehabilitation potential was assessed by their lower than expected IQ scores, rehabilitation potential may also be under-estimated. For a schizophrenia patient with a low IQ score and lower years of education (or perhaps who had problems at school such as social adjustment issues), DA could help the patient reveal his/her latent abilities by helping the patient "catch-up" (via the DA intervention) on strategies or skills that might have been under-developed as a result of compromised childhood educational opportunities associated with prodromal problems. Hence DA affords opportunities (missed in some cases due to compromised education opportunities) to allow otherwise lower than expected IQ scores to be taken into account.

The Effect of Age

While Learning Potential seems independent of intellectual function (as measured by IQ scores), it is possible that other factors may affect Learning Potential. One other variable that can be a possible moderating factor is age. The motivation to investigate the age factor was also initiated by the conflicting conclusions reached by the two meta-analyses discussed in Chapter

2 about whether age has any effect on the outcome of cognitive rehabilitation (i.e., McGurk et al. (2007) and Wykes el al. (2011)). In Study 2, analysis of Group DA Intervention's and Group No Intervention's gain scores and age showed that age was not a significant predictor for Learning Potential. Although gain scores are related to changes in absolute WCST scores in Study 2, the results of Study 2 are different to the conclusion drawn from research on the effect of age on the performance of the conventionally administered WCST (i.e., how age affects absolute WCST scores). Boone and his colleagues administered the WCST to a group of healthy participants whose age ranged from 45 to 83 years. Age seemed to significantly affect performance specifically in the number of errors made and on the Conceptual Level Responses measure for those age 70 years and above. However, in comparing the number of categories achieved by those aged between 45 – 49, 60 – 69, and 70 – 83, no significant differences were found (Boone, Ghaffarian, Lesser, Hill-Gutierrez, & Berman, 1993). Rhodes (2004) conducted a meta-analysis of 34 studies and concluded that there was a difference in performance between younger and older adults on the number of categories completed and the number of perseverative errors committed on the WCST. Older adults tended to perform over a standard deviation worse compared to the younger adults with the perseverative error measure being more sensitive to the age effect.

Thus the general consensus seems to indicate an effect of age between younger and older adults on WCST performance. That no effect of age found in Study 2 is perhaps not so surprising as the age range of the participants in

Study 2 was not as large. The participants in this current study were younger (with age ranging from 21 to 56, and an average age of 32.94 years) compared to the ones in the literature. Furthermore, the youngest age group in Boone et al. (1993) would have been one of the older participants in this present study, and any age effect would not be expected to have much effect on the variance in the present study. Similarly, the older age groups in Rhodes (2004) were aged 55 years and above, which was way beyond the oldest participant in the present study.

The studies by Rhodes (2004) and Boone et al. (1993) were both conducted on healthy participants, and with schizophrenia patients the age effect could be different. Stratta, Prosperini, Daneluzzo, Bustini, and Rossi (2001) investigated the influence of age on schizophrenia patients' and healthy controls' performances on the WCST. Their results showed that while the schizophrenia patients generally performed worse on the WCST compared to the healthy controls, both groups showed no significant correlations for age (or education) with their WCST performance. Stratta et al. (2001)'s lack of finding of an effect of age on schizophrenia patients' WCST performance is consistent with the findings of Study 2, and the schizophrenia patients' age range of 22 – 59 years in Stratta et al. (2001) is also similar to that in the present study. Thus results from Stratta et al. (2001) and from the present study suggest that the effect of age on the WCST performance may be attenuated in the schizophrenia population. However the age range of Stratta et al. (2001) was similarly limited as in the present study. This limited age range may not have been sufficient to show any age effect and suggests that age was

not playing a role in the present Study 2. Future studies should pursue this issue with a wider age range of schizophrenia patients.

The Effect of Antipsychotic Medication

Besides age, medication dosage was another additional factor considered as a possible predictor for Learning Potential. Review of the literature on the effects of antipsychotic medication on cognitive functions showed mixed results. While the general consensus is that typical antipsychotic medication does not seem to have an effect on improving cognitive function of schizophrenia patients, the same consensus cannot be reached for atypical antipsychotic medication. A closer look at the participants in this study showed that 13 participants in Group DA Intervention were on atypical antipsychotic medication, and five were either on typical antipsychotic medication or a mixture of both typical and atypical antipsychotic medication. For Group No Intervention, 10 were on atypical antipsychotic medication and 8 were on a mixture of both or just on typical antipsychotic medication. Therefore, the majority of the patients on this study were on atypical antipsychotic medication. The current study showed however that medication dosage was not a significant predictor of Learning Potential. This result was also replicated for Group No Intervention. From this study, it therefore appears that atypical antipsychotic medications do not significantly improve cognition. However the more important issue here is assessing the value of looking at a patient's medication (whether it is type of medication or dosage) as a way of predicting a patient's Learning Potential. For this, the present study (other than the reason of a study result that showed medication dosage

as not predictive of a patient's Learning Potential status) is not supportive of using medication as a predictor of Learning Potential.

As for the choice of antipsychotic medication, additional factors are at play including the treating clinician's preferences in terms of knowledge and experience with different drugs, the patient's preference which may include perceived benefits and side effects of the drugs, the availability of the medication in the treating facility, and the affordability of the medication (Rocca et al., 2009). With so many extraneous factors influencing the choice of medication, it is likely that the ultimate decision of the medication type will be based on more than just clinical factors. Hence it may not be wise to use information about the type of medication to predict a patient's Learning Potential.

The Effect of Negative Symptoms

A final factor to consider in predicting a patient's Learning Potential is the presence or absence of negative symptoms. While the literature indicates a close association (whether direct or indirect) between negative symptoms and functional outcomes of schizophrenia patients, less is known about negative symptoms as a predictor of rehabilitation responsiveness. One study that investigated the relationship between negative symptoms and rehabilitation outcome was conducted by Bark, Revheim, Huq, Khalderov, Ganz, and Medalia (2003). Fifty-four schizophrenia patients were randomly assigned to receive 10 weeks of cognitive remediation or to a control group who received no intervention. All patients also received an assessment of their symptoms via

the administration of the Positive and Negative Symptoms Scale (PANSS) before the start of treatment, immediately after 10 weeks of treatment, and at four weeks post treatment. Neuropsychological assessment was also carried out at the same three time points. Cognitive remediation effects on psychotic symptoms were generally disappointing, and did not produce significant improvement over and above psychiatric treatment alone (which resulted in improvement in cognition). When baseline PANSS measures were analysed to see if they offered a predictive relationship with the change in cognitive outcome measures, no relationship was found other than the cognitive factor of the PANSS measure. Thus it appears that negative symptoms are not predictive of schizophrenia patients' performance on cognitive remediation (Bark et al., 2003).

If negative symptoms are not predictive of schizophrenia patients' cognitive remediation outcome, then by deduction, negative symptoms will also not be predictive of schizophrenia patient's Learning Potential because Learning Potential should indicate how well patients will perform in a rehabilitation program. Study 2 found no evidence that negative symptoms are related to Learning Potential. Even though negative symptoms are associated with cognitive deficits, differential treatment effect from cognitive remediation on psychotic symptoms (as seen in Bark et al. (2003)) suggests that certain aspects of negative symptoms may be independent from cognitive functions. This independence may also be deduced by the observation that while cognitive deficits tend to stabilise, symptoms vary over the course of the illness (Rund, 1998; Hughes et al., 2002). Thus even while Learning Potential

may_not be well-defined at the moment, the underlying process of DA is cognitive in nature (e.g., learning how to apply the three sorting rules or having to track sorting behaviour) and hence, it should be independent of the presence or absence of negative symptoms. Nonetheless, the result from this study needs to be interpreted with caution because the non predictive power of negative symptoms could be due to a restricted range of scores available for analysis. The participants' scores on the Negative_symptom scale of the PANSS were generally quite low (in both Group DA Intervention and Group No intervention) and did not vary very much. It is still possible therefore that a significant relationship could have been found between negative symptoms and Learning Potential had there been more variation in the patients' PANSS negative symptoms scores.

Learning Potential as an Independent Construct that is Useful in Assessing Rehabilitation Readiness

This study set out to investigate the independence of the Learning Potential construct from any moderating factors (e.g., IQ, age, medication, negative symptoms). The results suggested that Learning Potential as assessed by the DA paradigm is a unique construct that is not affected by schizophrenia patients' intellectual functions (IQ scores), age, medication, or negative symptoms. So far this is the only known study that specifically attempt to deconstruct Learning Potential to ascertain its properties._There is more to be done to further validate Learning Potential as suggested from the additional analyses this present study conducted on other possible moderating factors such as age, medication dosage, and negative symptoms. Nonetheless, results

from this study justify the argument that DA should be administered at least in addition to conventional intelligence tests as Learning Potential appears to be an independent construct from intellectual function.

The true usefulness of DA in assessing schizophrenia patient's rehabilitation potential can only be known however when the schizophrenia patients' rehabilitation outcome is examined in relation to their Learning Potential statuses. Watzke et al. (2008)'s study (previously discussed in the introductory section of this chapter) tracked the employment status of schizophrenia patients who earlier had their rehabilitation potential assessed and had received a vocational rehabilitation program. They found that 66% of High Scorers and 44% of Learners were either gainfully employed or had continued with supported work programs three months after completing the rehabilitation program. Conversely, none of the Non Learners had found any paid work at the three-month follow-up. This provides some support at least for DA's efficacy of predicting patient's rehabilitation outcome based on their Learning Potential.

A more recent study by Rempfer, Brown, and Hamera (2011) also showed that Learning Potential assessment predicted skill acquisition among people with serious mental illnesses. In addition to schizophrenia patients, the study included patients with unipolar depression and bipolar disorder. All patients attended a nine-session grocery shopping skill training program. Dynamically administered WCST showed that gain scores predicted skills acquisition while pre-intervention WCST assessment scores were not a significant predictor.

Rempfer et al. (2011) also specifically noted that when they assessed overall group performance on the grocery skill training tasks, the result did not show effective improvement in skill. However, individual gains in performance were predicted by the patients' Learning Potential statuses. This study provides support that the DA paradigm is able to predict rehabilitation outcome from the assessment of patients' Learning Potential. Rempfer et al. (2011) also highlighted an issue inherent not only in DA but also in conventional psychological assessment which is that ultimately, assessments are done to solicit understanding of an individual patient's capabilities. While validations of assessment paradigms are done from the group perspective, the eventual usage of these assessments is at the individual level. Therefore, the most important outcome is that the assessment must be able to accurately account for an individual patient's traits and abilities. Rempfer et al. (2011) showed that the DA paradigm was capable of predicting Learning Potential and rehabilitation outcome at the individual level.

Qualitative Analysis of Rehabilitation Outcome

The interest and uniqueness of the DA paradigm lies in its ability to make predictions on schizophrenia patients' rehabilitation potential. Though other research studies have assessed the predictive ability of DA (e.g., Watzke et al. (2008) and Rempfer et al. (2011)), a shortcoming of the present study was that rehabilitation outcomes of the participants were not measured. Nonetheless, the observation by Rempfer et al. (2011) inspired a highly exploratory exercise in the present study using a pseudo-case study method by studying the employment history of individual schizophrenia patients who were

randomized into Group DA Intervention. The aim was to relate this information to their Learning Potential statuses obtained via the DA methodology. This is highly exploratory and speculative (and no quantitative or statistical analyses were attempted). However such a method of study is not new in the field of psychology, and the single case-study approach is a useful step in building our understanding of Learning Potential and rehabilitation outcome.

The information was collected through interviews conducted with the patients while gathering demographic information during the study. The patients were asked about their employment details of the three months prior to the DA session and their employment status at that point of the session. Out of a total of 18 schizophrenia patients recruited into Group DA Intervention, eight patients were categorised as High Scorers, eight were categorised as Learners and two were Non Learners. Note that the categorical approach to Learning Potential was used here to facilitate the comparison with the findings of Watzke et al (2008) in which the categorical approach was also used (and the categorical versus dimensional approach to assessing Learning Potential will be further discussed in Chapter 6). Of the eight High Scorers, four of them were employed (see Table 6 for details). One of them was a full time student at the National University of Singapore in her third year of studies in the Business faculty. She was categorised as employed as her time could be considered fully utilised being enrolled in a demanding academic program. Two other patients were also gainfully employed: one as an insurance agent who had to manage existing customers' insurance policies and to solicit new

customers; and one as a temperature checker who had to handle rotating shift work. The fourth patient worked full time as an administrative clerk, which was a downgrade from her previous job as a primary school teacher, but it was a carefully considered decision (the patient commented that she did not want the stress_from working as a teacher to affect her health). Being classified as High Scorers suggested that had they been selected for rehabilitation, they would have benefitted from it and that would have translated into gainful employment. Through such_reasoning, their employment statuses would be considered as a support for the DA methodology in predicting their rehabilitation potential.

The same reasoning would also be behind the prediction of the Learners status and employment status. Even though the Learners may have had lower initial performance, the fact that they are able to benefit from the coaching provided during the DA intervention indicates their Learning Potential, and it would be interesting to see if their Learning Potential status could also predict a positive outcome from rehabilitation programs. Of the eight Learners in this study, seven of them were gainfully employed. Five of them worked in full time positions. The remaining two worked odd jobs or worked part time. While there was a range in the type of jobs they held, the fact that they were able to hold down jobs despite their illnesses is at the very least encouraging for the relationship between Learning Potential and future employment status. Turning now to the Non Learners, because of their low assessment of Learning Potential via DA, their rehabilitation outcome and hence employability would not be expected to be as positive. There were only two

Non Learners in the present study, but neither of them were employed in the period of three months before and during the DA assessment period.

Thus when considering the schizophrenia patients in Group DA Intervention of the present study, a comparison of the employment statuses and their corresponding Learning Potential statuses showed a very similar pattern to that of Watzke et al (2008). The present study is at the very least consistent with the idea that DA of Learning Potential could provide value in predicting rehabilitation potential and future employability of schizophrenia patients. Nevertheless, it needs to be reiterated that this conclusion is highly speculative and based on qualitative records of only 18 cases. The efficacy of DA's rehabilitation potential prediction should therefore be properly investigated in future studies.

Table 6
Employment Status of Schizophrenia Patients in Group DA Intervention

Patient	Learning Potential Status	Employed Currently? (Yes/No)	Employment Detail
1	High Scorer	No	Worked in McDonalds for a year many years ago
2	High Scorer	Yes	Full time 3rd year Business faculty National University of Singapore student.
3	High Scorer	Yes	Full time insurance agent
4	High Scorer	Yes	SIM University student. Taking a break now. Working as a temperature checker instead
5	High Scorer	No	Had tried working as a administrative officer, and studying at SIM University
6	High Scorer	No	Had worked as a quality surveyor and a pre-school teacher previously
7	High Scorer	No	Cannot remember when was the last employment (too long ago)
8	High Scorer	Yes	Administrative clerk. Previously a primary school teacher for 12 years
9	Learner	Yes	Full time sales coordinator
10	Learner	Yes	Used to be a regular in the Republic Singapore of Navy. Now an odd jobber (part time)
11	Learner	Yes	Case manager (in social work related field)
12	Learner	Yes	Recently switched job from a temperature checker to an administrative worker
13	Learner	Yes	Shop assistant (part time)
14	Learner	Yes	Carrefour cashier
15	Learner	Yes	Drafts person
16	Learner	No	Kept talking about plans to further education with no mention of previous employment
17	Non Learner	No	Resigned from MOE 8 years ago as a Tamil teacher. Not working since
18	Non Learner	No	Cannot remember when was the last employment (too long ago)

Note. Patients were asked to report their employment history from three months before and until the time of the DA assessment session.

Conclusions from Study 2

Since the development of DA, proponents of this assessment paradigm have continuously tried to study and improve its efficacy (Guthke & Stein, 1996; Wiedl, Schottke, Green, & Nuechterlein, 2004). Despite positive results, the incorporation of DA in the treatment of schizophrenia patients is still not a regular practice. One reason may be that more time is needed to administer DA compared to the conventional testing format. The DA paradigm has an extra intervention and post-intervention assessment session compared to single assessment session usually utilised in the conventional paradigm. This runs contrary to the trend and pressure faced in the psychological testing field, which is to use abbreviated tests and to reduce assessment time (Schrimsher, O'Bryant, O'Jile, & Sutker, 2008; Axelrod, 2002; Kamphaus, Petoskey, & Rowe, 2000; Camara, Nathan, & Puente, 2000). Therefore, this extra administration time is a shortcoming of DA. However the results of Study 2 show that the shortcoming of requiring extra time for the intervention and post assessment adds predictive value in terms of Learning Potential that still warrants its adoption in place of traditional static assessment procedures. This was supported by the results showing that TCR performance derived from the conventionally administered WCST (pre- intervention assessment score) was not predictive of Learning Potential (as measured by the gain scores). Moreover, since IQ may not be a useful indicator of rehabilitation potential, DA could be used in place of IQ tests (which in some cases require a longer time to administer than DA). Thus DA may require extra time to administer but in the long run it may help clinicians more effectively utilize healthcare

resources by more accurately matching the appropriate patients to the rehabilitation programs.

Chapter 6: Conclusion and Reflection

Based on Study 1 and Study 2, there is much potential in Dynamic Assessment (DA) in terms of assisting clinicians to make decisions relating to a schizophrenia patient's rehabilitation and functional outcomes. However, because the use of DA in managing mental health patients is relatively new, there is a need to reassure clinicians about the DA's efficacy before they will consider incorporating DA into their usual practice. The validation of any new assessment test, not to mention a new assessment paradigm, is however a gigantic task. Such validation would include a thorough exploration of the construct itself, the suitability of the assessment tests to be used, the assessment procedures inherent in the new assessment paradigm, the validity and efficacy of the tests and procedure in assessing the construct, and the reliability of the assessment tests and procedures. Such a project would involve an investment of both time and financial resources far beyond the scope of this thesis. However these obstacles should not prevent researchers from venturing into such research and the research presented in this thesis is a small part in this validation endeavour. It was with this intention in mind that led to the formulation of the two studies in this thesis.

The aim of Study 1 was to investigate whether the DA intervention could be explained by simple practice effects rather than the development of mediational learning as is claimed by DA proponents. The result of study 1 showed that the DA intervention could not be explained by practice effects, and that it produced improvements in performance that were mediated by

changes in perseverative behaviour among those schizophrenia patients who had received the DA intervention.

The key construct of DA, Learning Potential was studied in relation to intellectual function in Study 2. No relationship was found between Learning Potential and intellectual function. In addition, Study 2 also explored the possible role of DA in predicting functional (employment status) outcomes. There was indication of strong association between Learning Potential and active employment status.

Study 2 also explored the possibility of relationships between Learning Potential and other factors such as age, medication, and symptoms. No evidence that age, medication, or negative symptoms served as possible predictors of Learning Potential was found. Other than the non-significant results, reasons were also provided on why each of these factors may not be expected to predict Learning Potential at least among the current studies' participants.

The Ceiling Effect from the Dynamic Assessment Version of the Wisconsin Card Sorting Test

At this juncture, it is important, however, to consider several caveats that need to be taken into account when interpreting the results from Study 1 and Study 2 of the present thesis. As mentioned in the Discussion section of Study 1, there may have been ceiling effects encountered when using the DA version of the Wisconsin Card Sorting Test (WCST). The WCST may have become too

easy when used in the DA pre-test - intervention - post-test design to assess the full range of Learning Potential. The likelihood is that it would lead to under-estimation of Learning Potential in those individuals who are considered High Scorers. This is interesting because only 50% of High Scorers in Study 2 were gainfully employed in the 3 months before and during DA assessment. While Learning Potential in High Scorers in terms of gain scores might be low (because of the ceiling effect), there is the possibility that some High Scorers may actually be "untrainable" and the development of a more difficult DA assessment tool might have allowed such evidence to come to light about these High Scorers. Further studies should explore an alternative and more difficult test when assessing Learning Potential. The WCST is widely used in the DA literature but it will be good for the field of DA to explore other tests that may also be equally or even more predictive in the assessment of Learning Potential. The California Verbal Learning Test (CVLT-II) may be a test for consideration, since Fiszdon et al. (2006) had used it to differentiate performance in schizophrenia patients when DA intervention was incorporated into the patient's assessment paradigm.

The Non-Utilisation of DA Strategies Despite Good Learning Potential Statuses

Another possible interpretation of the good performance achieved after the DA intervention on the WCST is that some participants might still be using executive functions as assessed by the conventional WCST despite of the intentional mediation strategies adopted following the DA intervention (i.e., the coaching given to the participants about the sorting rules and the self-

monitoring that could help them adapt their behaviours to avoid perseveration whenever the rule changed). Even though the participants would know which rules were possible and they could count the number of trials they had successfully performed and predict when the rule change would occur, they would not however know which rule was coming up next (during the DA intervention, the participants were not told that the sorting rules were always in the order of colour, shape, number), and so although the participants might know when the rule was about to change, they would not know (any more than those participants from other groups) what the next rule would be, and would therefore still need to make a guess and watch the feedback carefully to understand whether they needed to adapt their behaviour to responses based on the other rule. While it is difficult to argue against this possibility, if this were true, then the participants would still have to use the very conventional "WCST-like" trial-and-error approach to identify the new rules, and to watch the feedback carefully at the critical times of a rule change to be able to understand how they needed to adapt their behaviour to be more successful. An argument could therefore be made that after the DA intervention, even if the participants would still be relying on executive functioning, but perhaps that they would know more about when they needed to more carefully monitor the feedback in relation to their behaviour. This in itself does not seem to be overly problematic either, and the fact that the participants were able to understand and make use of this strategy to predict when the time came for them to pay more attention to using the environmental cues to guide their behaviour could perhaps be taken as further evidence that they might benefit from rehabilitation programs.

Determining Learning Potential - Categorical or Dimensional Approach?

Another area that warrants more research is the way that Learning Potential is determined. Currently there are two methods that are usually used to determine the Learning Potential of schizophrenia patients: the categorical approach popularised by Wiedl and Wienobst (1999), and the dimensional approach developed by Sergi et al. (2005). The popularity of the categorical approach was probably due to the fact that DA research in schizophrenia patients began with this approach of assessing Learning Potential with the seminal work of Wiedl and Wienobst (1999). Thus research studies that followed typically adopted the same categorical approach until recently when Sergi et al. (2005) developed a new dimensional way of determining Learning Potential. Aided by the long standing debate about categorical or dimensional approach to mental disorders (Widiger & Samuel, 2005), the same issue of which is a more appropriate way of identifying Learning Potential as it appears also reached the field of DA. A few studies have actually assessed these two approaches, and not surprisingly found that the dimensional approach was more sensitive to the range of Learning Potential compared to the categorical approach (e.g., Vaskinn et al. (2009)), and other studies advocate the dimensional approach because it provides greater statistical power (Rempfer et al., 2011). The dimensional approach was adopted for Study 1 for the same reason because it would yield greater statistical power. However categorical approach is still popular as it is easier for studies to compare results with each other as majority of the literature on DA is using the categorical approach. When exploring and speculating on the relationship between employment status and Learning Potential of schizophrenia patients,

the categorical method was used to differentiate the different learning status groups. This categorical approach was chosen so that this study's exploratory result and Watzke et al. (2008), which was using the categorical approach, could be compared directly. However, this also illustrated a problem, which is that methodological differences not only lead to difficulty in comparison between similar research but it also makes the generalisation of findings more difficult (Fiszdon & Johannesen, 2010). This problem is not unique to the field of DA but it still shows that there is a need to investigate these different approaches of defining Learning Potential within the DA paradigm.

Small Sample Size Effect on Study Results

A major limitation, specifically for Study 2, is the issue of small sample size. This small sample size may have led to under powered statistical analyses. For Study 2, it is possible that with bigger sample size, intellectual functions, age, medications and negative symptoms could have all been significant predictors of Learning Potential. Moreover, the fact that not all High Scorers and Learners were gainfully employed, as illustrated by this study's High Scorers and Learners as well as those from Watzke et al. (2008), showed that some other factors could be interacting with the patients' Learning Potential and their rehabilitation outcome. There was consideration of administering the DA intervention to the participants in Group WCST Intervention and Group No Intervention of Study 1. However, since these participants were not naive to the WCST protocol, there was the problem of the practice effect interacting with effect from the DA intervention. Moreover ethical guidelines did not allow for re-testing of these participants. This plan of increasing the sample

size of Study 2 through retesting was eventually dropped. Therefore, the demonstration of independence of Learning Potential from any interacting factors warrants more investigation in larger samples in future studies.

This possible lack of power seemed less of a problem in Study 1. Study 1 showed that the DA intervention was more than just practice effect, and supports a cautious confidence that DA could be assessing a unique construct (Learning Potential). However future studies should certainly further re-explore this issue with bigger samples.

Future Research Direction

Future studies should expand on the current understanding of the efficacy of DA in predicting the rehabilitation outcome of schizophrenia patients from their rehabilitation potential status. To be an effective predictive tool, different rehabilitation outcomes predicted by Learning Potential should be individually studied. After all, the type of rehabilitation programs schizophrenia patients are referred to are varied and ranges from cognitive, social skills, to vocational rehabilitation. Thus, establishing the efficacy for the prediction of each of this rehabilitation outcome becomes a must if DA is to establish itself as a tool with predictive value. Modern style psychological assessment has a long tradition in this field and it takes a long and protracted process for an assessment tool to be accepted within the field. For example, the Stanford-Binet Intelligence Scales went through several revisions from the original 1905 Binet-Simon Scale, translated into the English version by Henry H. Goddard, redeveloped by Lewis M. Terman before the intelligence test took a

form that is similar to what it looks like today (Wasserman & Tulsky, 2005). All these happened while the debate on intelligence was still ongoing, even until today. Anyone trying to change or break a time honoured tradition is bound to find resistance. Thus, it is not surprising that proponents of DA will find scepticism as they introduce a new testing paradigm. Being relatively new compared to conventional psychological assessment, DA is still on its road to answering to such critics. Even though shortcomings in the two studies in this dissertation limited the extent of conclusion that can be deducted from the results about DA, these two studies have still contributed knowledge into the overall enormous enterprise to establish the efficacy of DA.

The Issue of Clinical Utility

Other than using psychometric soundness as a guide by clinicians when choosing assessment tools, clinicians should also consider the clinical utility of the chosen assessment tools. Clinical utility emphasizes the ability of an assessment tool in making "improvements in clinical services and, accordingly, results in improvements in client functioning" (Hunsley & Mash, 2007, p. 32). In another words, an assessment tool should also have an added value of helping clinicians make better decisions with regards to the types of treatment a patient should receive. With better decision, the effect trickles down to the patient who will have a better match between his/her needs and the treatment, and thus, better treatment outcome. These are the type of considerations a clinician should also make when choosing an assessment tool in order to move towards a more evidence-based assessment, which has grown in attention and emphasis in this field (Hunsley & Mash, 2007).

The DA paradigm fits the characteristics of an assessment tool that serves the function of clinical utility. The assessment of Learning Potential helps clinicians make more informed decisions as to who is ready for rehabilitation, thus improving on the deliverance of clinical service. Taking one step further, clinicians can also potentially make a better fit between patients' potential and the type of rehabilitation to send the patient to, rather than just recommending any kind of program to the patient. For example, for a patient with poorer Learning Potential, rather than sending the patient for higher level work-skill rehabilitation, the clinician can recommend the patient for more basic life-skill related rehabilitation. With a better fit between patient and rehabilitation intervention, the chances of the patient benefiting from the intervention should improve. This is also a point echoed by Silverstein and Wilkniss (2004) where they discussed the future direction of cognitive rehabilitation for schizophrenia patients. Silverstein and Wilkniss (2004) argued for a need to tailor intervention according to a particular patient's cognitive profile, given the heterogeneous characteristic of cognitive deficits among schizophrenia patients. The DA approach allows a clinician to do exactly as proposed by Silverstein and Wilkniss (2004).

Moreover, in today's healthcare climate, the main stakeholders involved in the assessment process are not just the clinician and the patient, but also the governmental bodies (e.g., health ministry) and increasingly, insurance companies. Since these stakeholders either subsidize or pay for the assessment, they will want to know about the costs and benefits of each of these assessments as these are factors that will either affect the budget needed

to provide for such services or they affect the company's profitable margins. For such stakeholders, the justification of using assessment tests based on the reliability and validity properties of these assessment tools may not be enough. It is equally important to establish how good the tool is in improving treatment outcome (i.e., its clinical utility) so as to justify the cost of paying for the procedure (Meyer, et al., 2001; Yates & Taub, 2003). With improved treatment outcome, patients may also be able to return to work and contribute to the society and economy instead of being burdensome on society. Thus, developers of psychological assessment tools may soon face increasing pressure to state the clinical utility of their tools.

There is no doubt that establishing the clinical utility of assessment tools will be as long and arduous a process as the validation of reliability and validity of assessment tools. Despite the effort required, developers or advocates of psychological assessment tools should not shy away from such an exercise. One will see that establishing the clinical utility of the assessment tools is beneficial to the general field of psychological assessment, and is especially important for proponents of DA who are trying to persuade more clinicians to use it. For the field of psychological assessment, justifying the cost-benefit of its procedure may mean more subsidy or cost coverage. This may translate into more patients being willing or be more acceptable to undergo psychological assessment, raising the profile of psychological assessment as an essential part of treatment, maybe as essential as medical procedures. This is especially important for DA who has a clear advantage in terms of clinical utility. Establishing the cost-benefit and clinical utility of DA will help it

gather more subsidy or coverage from organisation who dispense healthcare budget, which will make clinicians more inclined to administer DA. Overall, it is a win-win situation for both the field of DA and the field of psychological assessment in general.

Dynamic Assessment Complements Conventional Assessment

In a restrictive funding environment for healthcare services, it is important for clinicians not to waste any resources so that more patients can enjoy healthcare services. DA has the potential to cut wastage by ensuring a better fit between patient's characteristics and rehabilitation services. Rather than competing with conventional psychological testing paradigms, DA paradigm should be seen as an extension of conventional testing method (an intervention plus an extra conventional assessment). Its role is in assessing Learning Potential, in which conventional psychological fall short. DA is not a replacement but it adds a new assessment dimension. DA and conventional psychological testing all add to a clearer picture of a patient's characteristics, which helps clinician formulate a tailored treatment plan for the patient.

Operationalization of the Zone of Proximal Development using the Dynamic Assessment version of the Wisconsin Card Sorting Test

This thesis set out to establish the efficacy of DA and the empirical evidence for it is promising. The DA field based its theoretical underpinning on Vygotsky's zone of proximal development (ZPD) so it is timely at this concluding juncture to return to Vygotsky's ZPD and show how this thesis and DA proponents have operationalized Vygotsky's ZPD for the assessment of

schizophrenia patients' Learning Potential using the WCST. The concept of ZPD was explained by Vygotsky as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p. 86). Thus the patient's actual and potential levels of development need to be determined first. The patient's actual level of development is assessed by performance on the pre-intervention WCST assessment. To assess the patient's level of potential development, the DA intervention instructions on the WCST are provided to the patient. The "adult guidance" and "more capable peers" in Vygotsky's words would be the examiner in this case. The way the patient uses the DA intervention instructions and demonstrates it on the subsequent administration of the WCST (post- intervention assessment) will reveal the patient's level of potential development when post-intervention performance on the WCST is compared to that of pre-intervention performance on the WCST. Thus the breakdown of the DA paradigm into its component parts shows how each step in the assessment paradigm helps reveal a patient's ZPD which is the patient's Learning Potential.

Concluding Comments

This thesis is, to the best of knowledge, the first to investigate the DA paradigm in the Singapore context. Even though the validation and the acceptance of the DA paradigm within the Singapore context will take a much longer time to be fully established, this thesis demonstrated the potential of using DA within the local context. As clinicians start using the DA method,

this building momentum for DA research in Singapore context should lead to more follow-up studies. This was the case in Germany and Israel where there is a sizeable research output on DA generated from local researchers who followed from the works of Wiedl and Wienobst (in Germany), and Feuerstein (in Israel; see Murphy (2011)). With the healthcare system in Singapore constantly striving to have an integrated comprehensive treatment plan for schizophrenia patients, there is a great opportunity for this new type of intervention and treatment strategy. DA could also be one of the treatment strategies that improves the efficiency and effective of rehabilitation resource allocation in Singapore.

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Appendices

Appendix A: Demographics Questionnaire

Questionnaire on demographics and past psychiatric history

EXPLORING THE DYNAMIC ASSESSMENT PARADIGM AND ITS USEFULNESS AT ASSESSING LEARNING POTENTIAL OF SCHIZOPHRENIA PATIENTS
(5/8/2008 Version 1)

Subject Number:

1) Demographics (For patients to fill in)

P1) Your age **Pls write down your age:**					
P2) Your Gender	1 Male	2 Female			
P3) Your Race	1 Chinese	2 Malay	3 Indian	4 Caucasian	5 Other: (indicate)
P4) Your Education	1 Primary education or below	2 Secondary education or ITE	3 Pre – University and above		
P5) What is your housing type?	1) 1-2 room public	2) 3 room public	3) 4 – 5 room public	4) Private housing	

P6) What is your living arrangement	1) Living alone	2) Not living alone			
P7) What is your smoking status	1) Non smoker	2) Past smoker	3) Current Smoker		
P9) Your marital status	1) Married	2) Single	3) Divorced	4) Widowed	
P10) What is your occupation?					
P10) How much do you earn per month?	Rough estimate in Singapore Dollars	$			

2) Information of illness (For doctors to fill in)

1) Comorbidity

C1a) Generalised Anxiety disorder	**1. Yes**	**2. No**
C1b) Panic disorder	**1. Yes**	**2. No**
C1c) Agoraphobia	**1. Yes**	**2. No**
C2) Alcohol dependence	**1. Yes**	**2. No**
C3) Other substance abuse	**1. Yes**	**2. No**
C4) Personality disorder	**1. Yes**	**2. No**

C5) Obsessive compulsive disorder	**1. Yes**	**2. No**
C6) Eating disorder	**1. Yes**	**2. No**
C7) Post traumatic stress disorder	**1. Yes**	**2. No**
C8) Suicide attempt in past 3 months	**1. Yes**	**2. No**
C9) Depressive disorder	**1. Yes**	**2. No**
C10) Bipolar disorder	**1. Yes**	**2. No**

2) Treatment (partially have to be filled by doctors):

Treatment		**Name**	**Compliance (%)**
T1) Antipsychotics	**1. Yes/2. No**		
T2) Mood stabilisers	**1. Yes/2. No**		
T3) Antidepressant	**1. Yes/2. No**		
T4) Anxiolytics	**1. Yes/2. No**		
T5) Hypnotics	**1. Yes/2. No**		
T6) ECT	**1. Yes/ 2. No**		Number of times when ECT was given.

T7) Psychotherapy	**1. Yes/ 2. No**		

3) History of schizophrenia:

H1: Onset of schizophrenia (Year) 19__ / 20__

H2: Duration of untreated schizophrenia in months: _____

H3: Number of hospitalizations related to schizophrenia:
_____

Appendix B: Ethics Approval Document

National Healthcare Group
Adding years of healthy life

6 Commonwealth Lane
Level 6 GMTI Building
Singapore 149547
Tel: 6496 6600 Fax: 6496 6870
www.nhg.com.sg
RCB No. 200002150H

DSRB Ref: **A/09/050**

27 May 2009

Dr Roger Ho Chun Man
Department of Psychological Medicine
National University Hospital

Dear Dr Ho,

NHG DOMAIN SPECIFIC REVIEW BOARD (DSRB) APPROVAL

Protocol Title: Exploring the dynamic assessment paradigm and its usefulness at assessing learning potential of schizophrenia patients

We are pleased to inform you that the NHG Domain Specific Review Board has approved the above research project to be conducted in **National University Hospital**.

The documents reviewed are:

a) IRB & DSRB Application Form: Exploring the dynamic assessment paradigm and its usefulness at assessing learning potential of schizophrenia patients, **Version 1**
b) Study Protocol: **Version 1.0, dated 27 April 2009**
c) Participant Information Sheet and Consent Form: **Version 1, 27 April 2009**
d) Demographics Questionnaire: **Version 1, 27 April 2009**

The approval period is from **27 May 2009** to **26 May 2010**. The reference number for this study is **DSRB-A/09/050**. Please use this reference number for all future correspondence.

Continued approval is conditional upon your compliance with the following requirements:

1. Only the approved Participant Information Sheet and Consent Form should be used. It must be signed by each subject prior to initiation of any protocol procedures. In addition, each subject should be given a copy of the signed consent form.

2. No deviation from, or changes of the protocol should be implemented without documented approval from the NHG DSRB, except where necessary to eliminate apparent immediate hazard(s) to the study subjects, or when the change(s) involves only logistical or administrative aspects of the trial (e.g. change of monitor or telephone number).

National Healthcare Group

DSRB Ref: **A/09/050**

3. Any deviation from, or a change of, the protocol to eliminate an immediate hazard should be promptly reported to the NHG DSRB within seven calendar days.

4. Please submit the following to the NHG DSRB:

   a. All unanticipated problems involving risk to subjects or others, including serious adverse events (SAE) should be reported. In order to assist the DSRB, all reports should be accompanied by the NHG DSRB Unanticipated Problems Involving Risk to Subjects or Others Reporting Form. Please find all forms and guidelines on reporting on the internet at www.b2bresearch.nhg.com.sg.

   b. Report(s) on any new information that may adversely affect the safety of the subject or the conduct of the study.

   c. NHG DSRB Project Status Report Form – this is to be submitted 4 to 6 weeks prior to expiry of the approval period. The study cannot continue beyond **the expiry date** until approval is renewed by the NHG DSRB.

   d. Study completion – this is to be submitted using the NHG DSRB Project Status Report Form within 4 weeks of study completion or termination.

5. The NHG Research QA Program was launched sin May 2006. The program aims to promote responsible conduct of research in a research culture with high ethical standards, and to identify potential systemic weaknesses and make recommendations for continual improvement. This research project may be randomly selected for completion of self assessment worksheet or for a study review by the QA team. For more information please visit www.b2bresearch.nhg.com.sg.

Yours sincerely,

Dr Sim Kang
Chairman
NHG Domain Specific Review Board A

Cc: Director of Research, NUH (via fax only)
c/o Office of Biomedical Research, NUH

Chief, Department of Psychological Medicine, NUH